Outstanding Books

ANALYTICAL CHEMISTRY OF THE MANHATTAN PROJECT

Editor-in-Chief: CLEMENT J. RODDEN, New Brunswick Laboratory, U. S. Atomic Energy Commission. Division VIII. Volume 1. *National Nuclear Energy Series.* 369 pages, $6.75.

This volume deals with the analysis of and for uranium and other related materials. The text is divided into two parts. Part I. lists various elements and methods of determination. The chapter on Uranium, in particular, is one of the most complete compilations of past and present practices in the separation and determination of uranium. The second section of the book deals with physical methods which were developed for analysis by various procedures including spectrochemical, radiochemical, photometric, and electrometric.

FUNDAMENTALS OF OPTICS. New 2nd Edition

By FRANCIS A. JENKINS and HARVEY E. WHITE, University of California. 647 pages, $7.00.

Thoroughly revised, the scope of this widely-used text has been extended to include geometrical optics and the quantum behavior of light, considered in the final chapter, "Photons." Additional features include treatments of the phase contrast microscope, the interference filter, and such neglected topics as ray tracing and the effects of apertures in optical instruments.

PRINCIPLES OF PHASE EQUILIBRIA

By F. E. W. WETMORE and D. J. LEROY, University of Toronto. *International Chemical Series.* Ready in December.

A rigorous presentation of the heterogeneous equilibria in terms of laboratory criteria. The exemplary systems of one, two, three, and four components are chosen in a wide variety of types and arranged in such a way as to demonstrate both the common features and the general method of approach.

THE EFFECTS OF ATOMIC WEAPONS

Prepared for and in cooperation with the U. S. Department of Defense and the U. S. Atomic Energy Commission under the direction of the Los Alamos Scientific Laboratory, Los Alamos, New Mexico. 456 pages, $3.00.

An authoritative survey, presenting as accurately as is possible in the light of present knowledge, a technical summary of the results to be expected from the detonation of atomic weapons. The approach is not for the layman but designed rather to give every technically interested person an understanding of the effects of this enormous release of energy when used as a weapon in war.

Send for copies on approval

McGRAW-HILL BOOK CO., Inc.

330 West 42nd Street New York 18, N. Y.

Bulletin of the Atomic Scientists

Founded in 1945 by Hyman H. Goldsmith and Eugene Rabinowitch

Vol. VI November, 1950 No. 11

In This Issue:

Man's Use of Energy
Sir Harold Hartley 322

The Development and Future of Nuclear Energy
Sir John Cockcroft 325

The Atomic Age and the Belief in Progress
Michael Amrine 331

Control of Radiation Hazards in the U.S. Atomic Energy Program: Eighth Semiannual Report of the USAEC
Summarized by George V. LeRoy 332

Academic Freedom on Trial at the University of California
Geoffrey Chew 333

Civil Defense: Community Problems and the NSRB Plan
Frank Zeidler 337

Civil Defense News 338

United Nations Atomic Energy News 342

Book Reviews
"Minutes to Midnight" 344
"Atomic Energy" 347
"History of Nature" 348

Uranium Procurement Policies 349

Scientists Discuss War and Peace 350

News in Brief 351

Drawings by Martyl

Editor
Eugene Rabinowitch

Assistant Editor
Mrs. Alan Simpson

Publication Director: O. M. Forkert

BOARD OF DIRECTORS:

T. H. Davies
C. A. Hutchison
E. Rabinowitch
Edward A. Shils
John Simpson

BOARD OF SPONSORS:

J. Robert Oppenheimer, Chairman
Harold C. Urey, Vice-Chairman

H. A. Bethe
P. W. Bridgman
Detlev W. Bronk
A. H. Compton
E. U. Condon
F. Daniels
L. A. DuBridge
Albert Einstein
James Franck
S. A. Goudsmit
T. R. Hogness
F. W. Loomis
Philip M. Morse
H. J. Muller
Linus Pauling
G. B. Pegram
I. I. Rabi
Julian Schwinger
Cyril S. Smith
Leo Szilard
Edward Teller
V. F. Weisskopf
Sewall Wright
J. R. Zacharias

Published monthly by the Educational Foundation for Nuclear Science, Inc., 956 E. 58th Street, Chicago 37. Phone: Midway 3-3056. Manuscripts should be sent in duplicate to Mrs. Alan Simpson at the above address. Subscription and advertising service: All correspondence in regard to changes of address, new subscriptions, and advertising rates, should be sent to 53 W. Jackson Blvd., Chicago 4, Ill. Subscription—$5.00 a year. Single copy—50 cents. Four weeks notice is required for change of address: both old and new addresses must be given.

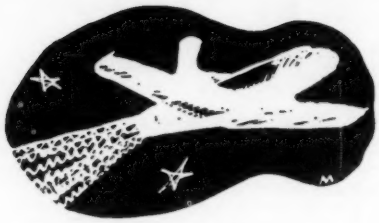
Entered as second class matter at the Post Office at Chicago, Illinois, under the act of March 3, 1879.

The opinions expressed in the "Bulletin" do not represent the official views of any organization.

Copyright, 1950, by the *Educational Foundation for Nuclear Science, Inc., Chicago 37, Illinois.*

MAN'S USE OF ENERGY

Sir Harold Hartley



In his Presidential Address to the British Association, Sir Harold Hartley traced the history of man's development and use of energy. The latter portions of this lecture, dealing with present-day problems of conserving existing resources and tapping new sources, solar and nuclear, are presented here. Sir Harold was Chairman of the World Power Conference which met in London last summer, and was the British government delegate to the United Nations Conference on Conservation and Utilization of Natural Resources held at Lake Success in 1949.

WHAT measure have we of the significance of energy to man today? In the nineteen-thirties the correlation between the average real income and the consumption of energy per head in different countries was so close, with a few exceptions, that it showed how essential supplies of energy are if a reasonable standard of life is to be maintained. Energy is the multiplier of human effort. But its effects are not found in comfort and productivity alone. The rapid interchange of persons and ideas has brought the world together into a much more closely integrated unit. It has quickened the senses and the nerve fibers of nations and given them a new awareness of events, a new world consciousness which, in due time, must show their inescapable community of interests.

With all these new uses of energy and its growing population, the world's demands are rising daily. How can they be met?

WORLD CONSUMPTION AND WORLD RESOURCES OF ENERGY

The world's consumption of every kind of energy today, food for men and beasts, heat, light, and power, needs a gross yearly intake equivalent to four thousand million tons of coal. On a thermal basis this demand is met by food from agriculture, 21 per cent; by coal and lignite, 41 per cent; by wood, 6 per cent; by oil, 24.5 per cent; by natural gas, 6.5 per cent; and by hydro-electricity, 1 per cent; so that about 30 per cent comes from the current revenue of plant and animal growth and water power and the remainder from the capital resources of coal and oil. Leaving aside the work equivalent of human and animal labor, and taking into account the efficiency with which the other energy sources are applied by man, their useful contributions today are, roughly: solid fuel, 56 per cent; liquid and gaseous fuel, 37 per cent; and water power, 7 per cent.

What of the future? How long can the world's resources meet these growing demands? The world's reserves of coal are ample for centuries. Reserves of oil and natural gas are smaller, and harder to define; but fresh fields are being found, and there is no reason to fear a shortage for some decades. Before then, synthetic oil from coal and the huge reserves of oil in shale will provide substitutes. Turning now from fossil fuels to current revenue, if the world's reserves of water power were all to be developed, their output would equal the total inanimate energy man is using today. But these reserves are scattered, and many lie in distant regions far from the crowded areas of the world—in the Belgian Congo, French Equatorial Africa, the Cameroons, and South America; and, like coal and oil, there is a most unequal distribution of resources between nations. The countries north of latitude 20° contain 94 per cent of the world's coal reserves and 83 per cent of the oil reserves, while those to the south contain two-thirds of the world's water-power potential, so that the pattern of development of countries, which must be related to their energy resources, will inevitably be very different.

But our energy problems of the future are not limited to heat and power alone. Reserves of fertilizers for the growth of food, and of metals for the machine age in which we live are of equal moment. Fortunately for agriculture the deposits of phosphates and potash will meet our needs for centuries, and nitrogen can be fixed from the air. But again, the reserves of phosphates and potash are most unequally divided, marking the dependence of one country on another.

Reserves of metals may present the world before long with a much more difficult problem. There will be no lack of iron, aluminum, or magnesium, although with lower grades of ore the cost may rise. Estimated reserves of copper, zinc, lead, and tin are adequate only for some decades, and, if all the world used them at the same rate as the United States, there might be shortages within ten years. Geologists are not optimistic of finding large new ore fields, and so we shall be faced with an iron/light alloy metal economy, reserving certain non-ferrous metals for the uses for which they are essential. Here again, the accidental distribution of ore deposits reveals the interdependence of countries in an acute form.

The global sufficiency of energy reserves is but a poor consolation for the countries that have few. The recent State Department Survey shows that half the world's visible reserves lie in the United States or the USSR, and another third in nine other countries. Of the remainder, none can claim as much as 1 per cent, so that their long-term development may call for new techniques. These inequalities are reflected in consumption today. At one end of the scale the United States uses yearly the equivalent of 9 tons of coal per head, while at the other, India and China are using less than one-fifth of a ton per head. The figure for Great Britain is a little more than 4 tons, of which one-third provides domestic needs of heat, warmth, and food, leaving nearly 3 tons for transport and industry.

What part is energy to play in the problems the world is facing now—the destruction and disruption of war, the

The *Bulletin* thanks the British Association and the editor of *Nature* for permission to reproduce Sir Harold Hartley's address.

economic unbalance of the older countries, and the claims of the less-developed countries with their ill-nourished millions for a better share in the world's dividends? Energy is essential to increased production both in the factory and on the farm. The needs of the more backward countries are transport, fertilizers, irrigation, heat, and power: transport to diversify their social and economic pattern; fertilizers to sustain and increase fertility; irrigation to bring the water on which all life depends; and heat and power to develop their indigenous resources.

THE NEED FOR GREATER EFFICIENCY

All this means fresh demands. The nineteenth century was wasteful of its easily won materials, but now, thanks to the continuous improvements in technique, the world's demands for heat and power are being met largely by improved efficiency. In Britain until 1938 the total fuel consumption was almost unchanged for a quarter of a century. During that time the population increased by 10 per cent. The use of heat and power in industry was extended to secure increased production from human effort. New industries arose, and the standard of domestic comfort increased. The striking fact emerges that the additional energy required with the progress in those years came from the same amount of fuel by increased efficiency of use. But, as the wartime economies proved, there were still great improvements to be made, and that is still true today.

What are the prospects of meeting future demands by improved efficiency of existing practice, by the transport of energy, or by new methods and new sources? To simplify the problem I will discriminate between the four energy industries—coal, electricity, gas, and oil—and the uses of the products they provide. It is in the energy industries that the major advances have been made. The most modern types of plant in each have reached a point where only fractional progress is likely to be made, and where the limits may be the discovery of new alloys or the higher cost which the gain in efficiency would not justify. There are still large savings to be made by raising the standard of all plant to that of the best practice. The generation of electricity has a special problem of its own—the loss in the cooling water of the condensers of about 60 per cent of the heat employed. Where steam is needed for any purpose in addition to power, this loss can be avoided by using steam from the low-pressure side of the turbine instead of condensing it. In industries using steam, the generation of electricity before the steam is used for heating purposes would secure large fuel economies. The other plan of using low-grade heat for district heating involves heavy capital costs if it is introduced in built-up areas, unless hot-water heating systems are already installed; but it would be more attractive in new development schemes with a sufficient density of population. With the continuous increase in the demand for electric power and the heavy capital cost of generating equipment, the problem of the combined use of heat and power is of major importance.

Turning now from the energy industries to the use of heat and power in industry, in transport, and in the home, it is there that inefficiencies of one kind or another combine to make the overall efficiency of use in Britain probably less than 15 per cent. Here is the urgent need for large economies to save the coal that will be needed for increased production. The future of British industrial efficiency will be closely linked with the efficient use of coal, the main raw material on which British prosperity depends.

TODAY'S DEVELOPMENTS

Before looking to the future, let me touch on a few developments that lie immediately ahead. The gas turbine, a new prime-mover, has proved itself for aircraft use both as turbo-propeller and turbo-jet. Several land and marine types are now being developed to use gaseous, liquid, or solid fuels. It has the advantage of compactness; it can be used where no cooling water is available; and it is specially suitable for burning by-product or waste gases. Underground gasification of coal is being tried in several countries, and, if successful, the gas turbine may possibly be the best means of utilizing the gas obtained. In Britain much depends on the success of the gas turbine using coal by one means or another.

Kelvin's heat pump, the refrigerator in reverse, with its high efficiency of power in supplying domestic heat is now on trial. Its economy is greatest in latitudes where its use for air-conditioning in summer balances its use for heating in the winter. In industry, too, the principle of the heat pump is being applied with great economy to recover the heat lost in evaporation.

In Italy the internal heat of the earth has been used successfully in a geothermal power station on an ever-increasing scale for more than thirty years. Difficulties and dangers in drawing steam from great depths and using it have all been overcome. Italian engineers and men of science have set a great example that could be followed wherever thermal springs or volcanic steam are found.

Few advances have been made in using wind power, one of the earliest forms of energy used by man; but now, with the progress in aerodynamics, new experiments are being tried which may produce power economically to be fed into a grid system and thus save coal. At favorable sites in Britain it is expected that wind-driven generators weighing about 300 lb. per kw will produce 4,000 kwh per kw per annum.

FUTURE POSSIBILITIES

What new means of tapping Nature's stores of energy are likely to emerge and bring it where it is needed? The unequal distribution of energy sources will make its transport of increasing importance in the future, and here the possibility of transmitting electric power over long distances by high-voltage direct current has passed the experimental stage and is waiting for development. By this means it should be possible to transmit large blocks of energy economically for perhaps a thousand miles by underground or submarine cable and thus link consuming centers with new and distant sources of hydroelectric power. There is, too, the interesting possibility of linking the British and European grids and thus securing a better balance between capacity and requirements by taking advantage of the seasonal variations in capacity and the diversity of demand. Such a scheme would, of course, be complementary to the distribution of power by alternating current, and it offers an opportunity for the British to share in European cooperation without raising the delicate problems of supra-national authority. A link of 250,000 kw capacity should be of mutual service to both sides by providing the equivalent of a large modern generating station as stand-by plant.

The tides in favored spots are obvious sources of energy, and, if more courage had been shown in pre-war years in carrying out schemes like the Severn Barrage, they might today be economical and saving fuel.

Then, it is tantalizing to think of the immense amount of energy reaching the earth by solar radiation, and the small use we make of it. The energy reaching the earth's surface is some 50,000 times

as great as our consumption. Forty per cent of it is used in evaporating water and 1 per cent in lifting it into the atmosphere, whence we derive our water power. Most of the rest is absorbed and lost by radiation in the night. One per cent of the radiation falling on vegetation is used in photosynthesis, whence we derive our food and fuel. Many experiments have been tried to make more use of solar radiation—its concentration by mirrors to give high temperatures, its storage in hot water or melted salts, and the generation of electricity by the photo-electric cell or thermocouple. None has so far produced an economic solution, but sunshine is so often available at places remote from other energy sources that we surely have a duty to posterity to pursue long-term researches in this field while we are living on reserves.

One large-scale experiment in using solar radiation is being made by the French government on the west coast of Africa. A turbine will be driven by steam obtained by evaporating under vacuum the warm surface water of the sea at 28° C, the condenser being cooled by water at 8° C drawn from a depth of 400 meters. Another interesting possibility, in Egypt, is to drive turbo-generators in the Qattara Depression by water drawn from the Mediterranean forty-five miles away, relying on solar radiation to evaporate the water from the tail-race as it accumulates in the Depression.

Last year Sir John Russell spoke of the possibility of raising the efficiency of plant photosynthesis to produce more food in a given area. Experiments have shown that this is possible with certain algae, but the land-grown plant supplies the structure of its own factory and draws its own raw materials from the air and ground. The use of algae would be an industrial process, and the land-grown plant may prove to be the more economical in operating costs. However, the work on algae is in its infancy, and it would be premature to speculate about its economy.

Mayer ended his short prophetic paper in 1842 by saying that the inefficiency of the steam engine justified the attempt to produce "motion" by other means than the sacrifice of carbon and oxygen, for example, by electricity obtained by chemical means. An economical fuel cell in which the free energy of the oxidation of carbon is converted into electricity has so far evaded discovery, but it remains one of the long-distance goals of research.

NUCLEAR ENERGY

The story of nuclear energy shows what can be done if science is used lavishly with all the resources of the modern world to penetrate Nature's secrets. Now, having wrested Nature's secret from her, comes the task of using her great storehouse for the good of man. I need not dwell on the advantages of that concentrated source of energy, with a potential several million times that of coal, if it could be tamed. Energy could be taken to remote places of the earth when it is needed. Deserts lacking only water might be made a paradise. But today the unsolved problems of these peaceful uses loom so large. Once more we see how hard it is to be creative compared with the ease with which man can destroy.

It is clear from the discussion at the Fourth World Power Conference, held in London this year, that the difficulties to be overcome before the use of nuclear energy becomes economical are most formidable, and their solution will require intense effort over a long period. New engineering materials must be found with properties never before investigated or required. They must be stable over long periods under intense neutron bombardment and must not cause loss of neutrons by absorption. The removal and disposal of the radioactive products from the reactors will be a costly and puzzling task. With the world's need of energy, it would be a tragedy if the fear of competition from nuclear piles were to delay in any way the immediate development of the more conventional and better understood sources of energy. It may well be that the first use of fissile elements will be to transport energy to places far remote from other sources. Meanwhile, the nuclear plants are yielding good dividends in the radioactive isotopes they produce. These provide a most powerful new technique of research, which has given us both a new understanding of many of Nature's processes and new methods of production control.

AUTO-MECHANISMS

The by-products and radiations of these nuclear plants are so dangerous to life that their operation is only made possible by automatic controls. This brings me to the latest chapter in man's use of energy, the new science of auto-mechanisms, which can replace the human senses and control machines. These modern robots may seem to bring us nearer to the fear of *Erewhon* of the mastery of the machine; but, just as the machine was the saver of manual labor, they are substitutes for the drudgery of the human brain. Today the energy of the electron is harnessed by photo-cells, by radar pulse, and other means through valves and amplifiers to watch and act. Usually these devices are more accurate than the human senses, and their action in micro-seconds eliminates the slow reaction time of man. They leave an automatic record, too, of what they have done. But in claiming the superiority of these man-made mechanisms for their specific purpose over man himself, I must make one exception. No auto-mechanism has, I think, approached the delicate perception of the sensory organ with which chemists are so well endowed—"Their noses infinitely wise. Their minds being memories of smells."

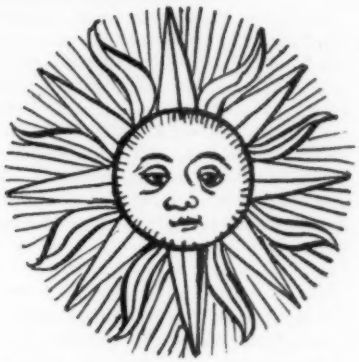
In any task that they are set to do, these controls must be fed with information to tell them when to act and the result. For example, in drawing wire through a die at constant tension, the auto-mechanism must detect a change of tension and at once adjust the speed of reeling-up until it knows the standard tension has been reached again, just as the senses tell the muscles how far their task has been performed. There are even electronic mechanisms to simulate the performance of their own kind and say how well, or ill, they do the work for which they are designed.

Sometimes the task is not so simple, and calculations are involved, and these the electronic computer can do much faster than the human brain; and there are calculating machines with electronic memories which can be set to make most complex calculations which would be impossible by human means owing to the time involved. These electronic computers can perform set tasks without ability to think. Errors may occur if a vacuum tube burns out or a switch fails to act, and now a new device enables them to detect such errors, locate them, and correct their own mistakes.

This latest venture in the use of energy must have most far-reaching effects. These automatic controls and precision techniques, consuming almost negligible quantities of current, will save manpower and add greatly to the economy of production, thus reducing the quantity of energy required. In the future, one of the indexes of economic progress should be, not the energy used per worker, but the output of goods and services per horse power employed.

THE DEVELOPMENT AND FUTURE OF NUCLEAR ENERGY

Sir John Cockcroft



The following article is the Romanes Lecture given at Oxford on June 2 by Sir John Cockcroft. Together with Dr. Walton, Cockcroft was the first to achieve artificial transmutation of atoms by particles accelerated in an electrical field. He is now Director of Britain's Atomic Energy Research Establishment at Harwell. The lecture contains one of the most authoritative and revealing discussions of the possibility of technical utilization of atomic power. The American reader will also be interested in Cockcroft's description of the history of the development of atomic energy in Britain during the early years of the war. This development, which contributed so much to the initiation and ultimate success of the atomic bomb project in America, is not familiar to most Americans, even to scientists, and is often overlooked in the discussion of whether American progress in atomic energy should be shared with Britain.

THE first evidence for the development of energy from a nuclear source came in the Renaissance of Physics which developed in the first years of this century after the discovery of radioactivity and the identification of the electron.

Until this time the Greek concept of Atomism still held its sway—the concept that the universe consisted of nothing but unchanging atoms and the space between them. The chemist still felt confident that with the methods at his disposal atoms were unchangeable and definitely indestructible. Occasionally some one thought he had transformed one kind of atom into another, but it had always been found possible to prove him wrong.[1]

THE DISCOVERY OF RADIOACTIVITY

This view was shattered by the experiments of Rutherford and Soddy carried out at McGill University in 1901–3, culminating in the famous *Philosophical Magazine* paper on "Radioactive Change," which showed that atoms of uranium, thorium, and radium were undergoing transmutation. About the same time—in March 1903—Pierre Curie and Laborde had shown that radium is continually generating energy. A radium source was found to maintain itself at a temperature of a few degrees above its surroundings, and a calculation showed that 1 gram of radium developed heat at the rate of 100 calories per hour. Curie and Laborde pointed out that the continuous release of such a quantity of heat could not be explained by an ordinary chemical transformation. If one sought for the origin of the production of heat in an internal transformation, this transformation must be of a most profound nature and must be due to a modification of the atom of radium itself. "If this hypothesis were correct," they pointed out, "the energy liberated in the transformation of atoms would be extraordinarily great."

This general idea was repugnant to the old-fashioned physicists of that time, and there was a prevailing idea that radium had a peculiar property of acting as a thermodynamic engine using heat from the air.

Rutherford, however, was firmly convinced that the heating was a necessary consequence of the emission of the high-speed alpha and beta particles which he had found to be ejected from radioactive atoms in the course of their transmutation.

He carried out experiments with Barnes which showed that the heat emission from radium together with its emanation was approximately proportional to the radioactivity of the materials as measured by the emission of alpha rays. In his paper with Soddy on "Radioactive Change" they pointed out that the energy of radioactive change must be at least twenty thousand times and might be a million times as great as any molecular change. The position was summarized in Rutherford's classical treatise on radioactivity published in 1904. "There was reason," he said, "to believe that an enormous store of latent energy was resident in the atoms of radioactive elements—energy which was derived from the internal energy of atoms. There seemed to be every reason to believe that the *Atomic Energy* of all the elements was of a similar high order of magnitude. Its existence at once explained the failure of chemistry to transform the atoms and also accounted for the independence of the rate of change of the radioactive processes of all external agencies."

Rutherford concluded with the prophetic sentence: "If it were ever possible to control at will the rate of disintegration of the radio elements, an enormous amount of energy could be obtained from a small quantity of matter."

This prediction by Rutherford was an example of his remarkable intuition, for at that time the structure of the atom and the nature of the forces which held it together were not understood. This understanding came five years later from the study in Rutherford's laboratory by Geiger and Marsden of the deflections in the paths of high-speed helium projectiles when they were fired through thin gold foils. Rutherford was puzzled by the enormous forces required to produce the observed deviations. In the course of one of those laboratory discussions, for which he is always remembered by his pupils, he suggested to Marsden that he should see whether these projectiles would bounce back from solid surfaces. To their surprise they did. Rutherford said later that it was as surprising to him

The editors are grateful to the Clarendon Press, Oxford, for permission to reprint this lecture.

[1] Rutherford, "Forty Years of Physics", in *Background to Modern Science*. New York: Macmillan Company, 1938.

as if a 15-inch shell had bounced back from a sheet of tissue-paper. He puzzled over the results for many months. At the end came the picture of the nuclear atom—the minute central nucleus carrying the electrical charge which produced the enormous electric forces required to deflect the helium projectiles in Marsden's experiments. Using his school copy of Loney's *Dynamics*, he worked out the dynamics and statistics of the collisions. Here, in the great magnitude of the forces, was the first real clue to the nature of "Atomic Energy."

ACHIEVEMENT OF CONTROLLED DISINTEGRATION OF ELEMENTS

The next step came in 1919 from the achievement by Rutherford of the controlled disintegration of elements by artificial means. During the 1914–18 war he took over some experiments by Marsden on the projection of hydrogen atoms by high-speed alpha particles. He varied the experiment to project nitrogen nuclei and found that *hydrogen* nuclei came out of them. "We must conclude," he said, "that the nitrogen atom is disintegrated under the intense forces developed in a close collision and that the hydrogen atom which is liberated formed a constituent part of the nitrogen nucleus." In this experiment, energy disappeared in the transmutation of the nitrogen atom, but in later experiments with Chadwick substantial gains of energy were found, when the atoms of boron, fluorine, and aluminum were similarly transmuted.

At the time of Rutherford's Bakerian Lecture in 1920 he did not appear to be nearer to an understanding of the source of these energy changes than he was in his Montreal days. There was speculation as to the amount of energy required to disintegrate the atom, and it was thought to be possible to produce disintegrations with less powerful agents than the alpha particle. These experiments were tried, but were not successful.

DEVELOPMENT OF THE MASS SPECTROGRAPH

The development of understanding came from the work of Dr. F. W. Aston, who returned from the 1914–18 war to build an instrument, which he named "the mass spectrograph," to investigate the weights of the atoms of the light elements. By 1920 he had shown that many of the elements were complex, consisting of several isotopes. The weights of the atoms of all the elements measured, with the exception of hydrogen, were whole numbers within the accuracy of measurement. The weight of a *hydrogen* atom proved to be nearly 1 per cent greater than unity. The significance of this observation to the release of atomic energy was not immediately drawn, but within the next year it was realized by many writers that if four hydrogen atoms were to join together to form helium, the 1 per cent of surplus mass would disappear, and from Einstein's law of the equivalence of mass and energy a substantial amount of energy would be liberated. Thus, at the Royal Society discussion on isotopes in 1921, Professor Lindemann referred to the difference between the mass of carbon 12 and that of the three helium nuclei which might join together to form it. He referred to the store of intra-atomic energy which "it is hoped will one day become available." Thus did Oxford foresee in 1921 what the rest of the world thought twenty years later.

Aston's second mass spectrograph, an instrument of higher precision, measured the masses of the light elements with an accuracy of one part in ten thousand. Armed with these results, it became possible to compare the energy changes in atomic transmutation with the changes of mass, and it was seen that Einstein's law was generally obeyed.

In spite of these successes the release of energy on any appreciable scale by nuclear transmutations seemed far away, for the number of such transmutations produced by the alpha particles from radium were numbered in hundreds or thousands a second only, and the total energy released was insignificant. There was, however, a general desire to increase the number of transmutations which could be produced, and Rutherford, on many occasions, expressed his desire for copious streams of atomic particles to be produced by the application of very high voltages. He wanted to obtain artificially produced particles to rival his alpha particles in energy, but to have them in far greater numbers. This seemed to be a somewhat difficult task in the rather restricted space of the Old Cavendish Laboratory, but we received notable encouragement by the application by Gamow of wave mechanics to the theory of nuclear collisions and transmutations.

It appeared that the mountainous barriers of electrostatic potential guarding the nucleus did not have to be scaled by our artificially produced hydrogen projectiles—they could, it appeared, wriggle through the mountain by reason of their wave-like properties. In practice this meant that hydrogen nuclei, speeded up by quite modest potentials, should be able to transmute nuclei of the lighter atoms. The predictions of the theoretical physicist and three years of hard labor by Dr. Walton and myself were rewarded when we saw scintillations produced by flying alpha particles on a zinc sulphide screen, showing that lithium nuclei were split up into alpha particles by our low-energy hydrogen projectiles. We were able to show that the energy in the flying fragments of the lithium nucleus was two hundred times greater than the energy of our primary projectiles and that this release of energy could be accounted for rather exactly by the loss of mass of the system.

The large increase in the number of transmutations now possible, together with the considerable multiplication of kinetic energy, raised once more the specter of a large-scale release of energy.

Since, however, only about one in a million of our projectiles hit the nuclear target, the over-all efficiency of the system was negligibly small. This did not prevent the press from exciting the world with the prospects of nuclear power, and I well remember Rutherford telling them in 1932 that the idea of obtaining power from the nucleus was "moonshine." In his national broadcast of 1933 he explained the reasons why such experiments excited so much interest in the scientific world. "It was not," he said, "that the experimenter was searching for a new source of power, or the production of rare or costly elements. The real reason lay deeper and was bound up with the urge and fascination of a search into one of the deepest secrets of nature." I can testify to the truth of this general attitude amongst scientists at that time.

DISCOVERY OF THE NEUTRON

During that same year of 1932—that *annus mirabilis* for the Cavendish Laboratory—Chadwick found that uncharged particles, neutrons, were emitted in nuclear transmutations, and these neutrons were shown to be most potent in producing further transmutations of matter, since they could enter easily into the heaviest nuclei, being unaffected by their powerful electrical defenses. Even then, however, the prospect of releasing nuclear power seemed just as remote, since our methods of producing neutrons were very inefficient.

For six years the key to the release

of nuclear energy lay before physicists. In Cambridge, Walton and I bombarded uranium with protons with the expected negative results. Rutherford and Oliphant bombarded uranium with heavy hydrogen and may have produced neutrons from heavy hydrogen films on their target, and these neutrons should have produced fissions. Professor Fermi, working in Rome, must have come even closer to the discovery in 1934, when he deliberately exposed uranium to neutrons and found a very complex series of transmutations which he then attributed to the production by neutron capture of elements heavier than uranium. At that time the concept of fission as a possible mode of transmutation seemed to occur to no one—we thought always in terms of transmutations of the, by now, classical type in which alpha particles or hydrogen nuclei or radiations were emitted, but never in terms of a splitting into two massive fragments. As Rutherford said on one occasion, "it is a characteristic of science that discoveries are rarely made except when people's minds are ready for them."

The general attitude at the end of 1937 was summarized in Rutherford's Henry Sidgwick Memorial Lecture to Newnham College, during which he declared that the outlook for gaining useful energy from atoms by artificial processes of transformation did not look promising. Aston, in his 1937 lecture on "Forty Years of Atomic Theory," took a rather more optimistic attitude. He predicted that nuclear chemists, armed with accurate knowledge of the masses of atoms, would in future be able to synthesize elements just as ordinary chemists synthesize compounds and that it might be taken as certain that in some reactions sub-atomic energy would be liberated. He thought that there was no doubt that sub-atomic energy was available all around us and that one day man would release and control its almost infinite power. "We cannot," he said, "prevent him from doing so and can only hope that he will not use it exclusively in blowing up his next-door neighbor."

THE PRINCIPLE OF FISSION

Aston could hardly have foreseen how near he was to seeing this hope fail. Strangely enough it was another chemist who first stumbled on fission. Hahn and Strassman, at the same time as Madame Joliot-Curie, were trying to elucidate by chemical experiments the numerous transmutations found by Fermi in uranium bombarded by neutrons. Madame Joliot-Curie had found elements behaving like lanthanum in the products; Hahn and Strassman found elements behaving like barium, lanthanum, and cerium; elements which no classical transmutation could have given. The evidence was at last too strong to be disregarded. Hahn and Strassman declared that as chemists they ought to declare that these elements really were produced. As "nuclear chemists," somewhat closely related to the physicist, they could not yet make up their minds to reach a conclusion which contradicted all previous experiences of nuclear physics.

This at last opened the eyes of the physicists, and within a few days a physical proof of fission had been obtained by Frisch and Meitner. From then on events moved fairly rapidly, for it became clear to many that if a fission process produced by a single neutron led to the emission of more neutrons, then, in principle, a chain reaction would be possible, and with it the dream of nuclear power might be realized.

POSSIBILITY OF THE CHAIN REACTION INVESTIGATED

In this country several tons of uranium oxide were collected together by Professor G. P. Thomson at Imperial College, and theoretical physicists went to work to calculate the conditions for the achievement of the chain reaction. In this they were handicapped by lack of experimental data. In Paris, Professor Joliot with his collaborators, Dr. Halban and Dr. Kowarski, showed by experiments with a spherical mass of uranium oxide and water that one primary neutron produced a total of at least eight further neutrons—they concluded that secondary, tertiary, and possibly higher order neutrons were produced and that a *convergent* chain reaction took place. This result was published on September 19, 1939, when we were already at war. For a time most of our nuclear physicists turned to the more immediate problems of the radar defense of our country, and nuclear physics was neglected by all save a few who stayed behind in universities to continue essential teaching work. I was amongst those who went to work on radar, but retained some interest in the nuclear work.

DEVELOPMENT OF THE ATOMIC BOMB

In April 1940 a memorandum was sent to Sir Henry Tizard, then Scientific Adviser to the Air Ministry, by Professor Peierls and Dr. Frisch who were working in Birmingham University. They pointed out that under suitable circumstances a chain reaction in uranium might be explosive and that the effect might be equivalent to a very large quantity of ordinary explosive.

A similar conclusion was reached by Professor James Chadwick, and Professor Geoffrey Taylor worked out in some detail the disastrous effects such an explosive might produce. On receiving these reports, the Ministry of Aircraft Production appointed a subcommittee of the Committee for the Scientific Survey of Air Warfare under the chairmanship of Professor George Thomson, and I remember meeting first with four other members in April 1940 a French officer who came to warn us that the Germans were working on this problem and were trying to obtain from Norway the world's largest stock of heavy water to investigate the possibilities of the chain reaction in uranium and heavy water.

This news brought a realization of the disasters which might befall us if the Germans were to produce an atomic bomb. We appreciated the great dangers from radioactivity which might be produced in such a bomb, and took some first steps in preparing instruments for civil defense work.

There has been a great deal of discussion as to whether scientists should have undertaken the work on the development of the atomic bomb. Looking back to the dark months of 1940 when this work was started, I do not think we had any doubts on the matter. The Germans had overrun Holland, Belgium, France, Denmark, and Norway, and freedom was fast disappearing from the world. Armed first with the atom bomb, Hitler could have conquered the world. We had serious doubts as to whether the project would succeed, but no doubts about the need to go on with the work.

After the fall of France in June 1940 the university physicists were reinforced by Dr. Halban and Dr. Kowarski, who were sent to us by Professor Joliot, bringing with them the 180 liters of heavy water which the French had succeeded in bearing away from

Norway before the invasion. They were instructed by Professor Joliot to try to continue in Britain the French project for the realization of a chain reaction in uranium and heavy water.

THE BOMB AND THE BOILER PROJECTS IN BRITAIN

We now had two quite distinct projects to work on—we called them "the bomb" and "the boiler." The first was the explosive chain reaction in the lighter isotope of uranium—uranium 235. The second was the non-explosive chain reaction which it was hoped to produce in a mixture of heavy water and uranium. Nuclear physics measurements for the bomb project were made at Liverpool and Cambridge whilst Professor Simon and Professor Peierls worked out the gaseous diffusion method of separating uranium 235.

For a long time the "boiler" was not thought to have any military importance—I remember one member of the committee suggesting that perhaps the heat developed in the boiler might be used to produce a powerful searchlight. By the end of 1940, however, the boiler project had also begun to have potential military value.

This came from the radiochemical work of Dr. Bretscher and Dr. Feather in Cambridge on the production by neutron transmutation of the two elements beyond uranium—elements which were already becoming known in Cambridge as neptunium and plutonium, after the two planets beyond Uranus. This work separated neptunium and determined its properties. It became certain then that plutonium was produced as a decay product. It was realized also that plutonium might be a nuclear explosive and at a meeting of the committee—now named the MAUD Committee—in January 1941 it was shown that adequate quantities of this explosive could probably be produced by thirty heavy-water piles. It was decided to urge the United States to produce plutonium on the large Berkeley cyclotron and to confirm its potential explosive properties. We found later that this work had been proceeding almost on parallel lines in the United States for some time—showing once more how scientific discoveries develop in many centers when the time is ripe for them.

A little later the workers on the boiler project found from their experiments with the 180 liters of heavy water and uranium that the chain reaction in this system was indeed likely to be divergent, and that a heavy-water pile could probably be built using between three and six tons of heavy water, a quantity which was far larger than existing world stocks. This was reported to the United States, and production of the necessary quantity of heavy water in Canada or the United States was urged.

By the middle of 1941, therefore, the general feasibility of the bomb and boiler projects had been established, although, since no confirmation of the properties of plutonium had been obtained from the United States cyclotron experiments, the boiler project was considered to be of secondary importance. So far the work had been carried on by a very small number of scientists—probably not more than twenty in all—and it was now time to decide whether the projects were to be taken more seriously. A report was therefore prepared for the government, and, on receiving this, Mr. Churchill issued his famous directive that "although personally I am quite content with existing explosives, I feel we must not stand in the path of improvement." The Chiefs of Staff thereupon directed that the work should proceed with the maximum priority.

BRITISH-AMERICAN WARTIME COLLABORATION ON BOMB PROJECT

For the next two or three years my own personal recollections of the project ceased, since the MAUD Committee was disbanded and a new organization known as "Tube Alloys" was established to carry through the project. The whole course of development in Britain was, however, modified by our developing relations with the United States. Senior United States scientists visited Britain and returned to stimulate their project to greater energy. At the same time negotiations were carried on between governments and it was decided, in June 1942, that since our resources were already fully extended on the war effort no large-scale plants for the production of atomic bombs should be built in Britain. There was, however, to be complete cooperation and sharing of results. Looking back on the situation at that time, this decision was certainly a correct one. Not only were we short of industrial effort, we were even more short of high-quality scientific manpower. Most of our nuclear physicists were engaged on the important development of micro-wave radar and I think there is no doubt that this contributed more to the successful outcome of the war than the atomic bomb.

The assumption of the main responsibility by the United States War Department led, however, in late 1942, to an almost complete cessation of cooperation, under a policy stated in a memorandum by Dr. Vannevar Bush to Harry Hopkins, by which information on the subject would be furnished only to those who needed it in the furtherance of the war effort.[2] It was recognized at once that the logical application of this policy would seriously affect the policy of full cooperation with the United States which had until this time underlain the atomic energy project.

This caused great concern to Mr. Churchill, and the subject was discussed at the Casablanca conference in January 1943. Mr. Harry Hopkins has referred to the discussion in his *White House Papers* and, in particular, refers to a cable in which Mr. Churchill said that if the full pooling of information on progress in nuclear fission were not resumed, then Britain would be compelled to go ahead separately in this work, and that would be "a somber decision."

Negotiations went on for six months in a manner which is by now all too familiar, and, in the end, by a decision of the Quebec conference in August 1943, cooperation was resumed in two ways. First, and most important, two small but high-power groups of scientists went to work in the United States. Second, the joint Canadian-British project which had been formed in 1943, under Dr. Halban's directorship, to build a heavy-water pile was reinforced. I joined the Canadian project and saw Canada playing her traditional and important role of acting as a link between the United States and Britain. This fruitful cooperation produced what has been described as the finest research pile in the world and made it possible to develop work in this country after the end of the war.

I do not think I need to describe the development of either the bomb or pile project, since so much has been written on both subjects. The nuclear chain reaction was first achieved in December 1942, in Professor Fermi's graphite pile built in the football stands of the University of Chicago.

[2] Harry Hopkins, *White House Papers*. Published in U.S. under title *Roosevelt and Hopkins* [R. E. Sherwood, Ed.]. New York: Harper and Brothers, 1948.

Subsequent piles developed as much heat as the largest of our power stations, and in so doing achieved the transmutation of the elements on a grand scale to produce the nuclear explosive, plutonium. The explosive chain reaction was realized later and ended, though it did not win, the war against Japan.

THE DUALITY FOR GOOD OR EVIL IN ATOMIC ENERGY

After this, nuclear energy held for a time the central role in the hopes for a new world in which weapons of mass destruction would be abolished. It was thought that the very ferocity of the new weapon would lead to a willingness for international cooperation to prevent its future use. This was coupled with a plan to develop nuclear power for industrial purposes by a major effort of international cooperation. This plan was based on a too optimistic estimate of the time-scale for nuclear power development. Unfortunately also, as we now know, these hopes were based on a too optimistic estimate of the world's political climate, and, after two and a half years of discussions, an impasse was reached. After the war our government decided that nuclear development was potentially so important, whether for peace or war, that this country could not stand aside from its development. The decision was therefore taken to found the Atomic Energy Research Establishment to act as a center of research in this field, and we decided to build our establishment at Harwell, on the outer perimeter of Oxford, my own preference for the outer perimeter of Cambridge being overruled by my colleagues, who did not, however, have to leave their Elysian fields. Since that time a production organization has also been established to produce nuclear fuel.

Those of us who decided to continue to work in this field after the war had to recognize the inescapable duality of nuclear energy—the same duality for good or evil in new inventions that has faced man since the first days of *homo sapiens*, a duality which is particularly marked in atomic energy, since some nuclear fuels can be used for nuclear explosives. It is important, therefore, to develop a sense of perspective and balance about this duality. This point of view has been particularly emphasized by Mr. Lilienthal in his book, *This I Do Believe*. He refers there to the myth of the atomic bomb—the myth that atomic energy is useful only as a bomb. I would like to quote some of his words:

"If the myth that atomic energy is simply a military weapon becomes a fixed thing in our minds, if we accept the error that it can never be anything else, we will never make it anything *but* a weapon....

"The myth will cause us to fall into an even deeper pit of error. We will grow forgetful of the true sources of a democracy's vitality and the true sources of our nation's strength. We will be misled into believing that America is strong because of military force alone, when, in truth, the foundation of our strength and amazing vitality is not in material things but rather in the spirit of this nation, in the faith we cherish."

Our task, then, was to explore the future of atomic energy, to develop the knowledge required to produce the basic nuclear fuels and in particular to develop whatever in this field was beneficial to our country.

POSTWAR BRITISH DEVELOPMENT OF ATOMIC ENERGY

Some immediate benefits were to be had from the fruits of the first three or four years of work. These came from the use of the atomic pile as a large-scale producer of radioactive forms of most of the elements. Already at Harwell we produce each month in our second pile more than 500 samples of radioactive forms of carbon, sodium, phosphorous, sulphur, iodine, cobalt, and many other elements. These go out to hospitals, universities, research institutes, and industry; they are flown by air to the farthest parts of the British Commonwealth and to all the countries of Western Europe. These radioactive forms of the elements are used for diagnosis of disease; in some rather special cases of malignant disease they are used for treatment. Their property of being traceable wherever they go by their radioactivity is leading to a most exciting unveiling of the very marvellous processes occurring in living organisms of all kinds. They are finding uses in modest but, in the aggregate, important ways in many branches of industry. We can, I think, fairly claim that science, medicine, and industry have been provided with new tools which will widen our knowledge and bring greater power over nature. Here at least is some important benefit of atomic energy.

Other benefits come to us from the use of the atomic pile as a new tool of research—a tool as important, perhaps, as the cyclotron. The pile provides the nuclear physicist with beams of neutrons which enable him to carry out new types of experiments on atomic nuclei. For example, work with the beams of neutrons from the Chalk River pile has shown that the neutron is itself an unstable particle. The solid state physicist uses neutrons as a supplement to X-rays to explore the structure of crystals. The chemist uses the radiations of the pile to disarrange and rearrange molecules and to study the influence of radiation on chemical reactions.

PROSPECTS FOR NUCLEAR POWER

A more difficult task and one which may bring benefit for the future rather than the present is the development of nuclear power. We might at the outset ask whether this objective is worth a great deal of present effort in view of the fact that our known coal reserves will last at least two hundred years or so. It is certainly true that we use our coal wastefully and that we should devote more effort to its efficient use. We should also direct some of our scientific resources to the utilization of the energy which the sun pours down on us so abundantly, though we really require some good new ideas for this development. But when all this is said, there still seems to be a case for devoting effort to the development of nuclear energy for power—for two hundred years is not a long time in the life of a nation. There may well be an increasing reluctance to spend a lifetime working below ground, and we should always remember that coal is a most important and irreplaceable source material for the chemical engineering industry.

What, then, are the prospects for nuclear energy? Superficially they appear good, for the complete destruction of one ton of uranium by fission releases as much energy as the burning of three million tons of coal. Furthermore, atomic piles have already operated for five years, developing continuously as much heat as our largest power-stations develop. These piles were built, however, solely to produce plutonium, and the heat is developed at too low a temperature for use in power development. Radical changes are necessary in atomic pile designs to make them suitable for power production.

The nuclear engineer has had four years to consider the problem since the war. During this time he has been able to formulate the technological problems to be solved and has started to work on their solution. He has, however, be-

come increasingly aware of their difficulties.

The problems become easier if he is asked to develop nuclear power units for specialized purposes, where the cost of the power is not particularly important and where the total amount of uranium required is comparatively small. It would seem probable that such specialized power units will be built within the next five years and that we shall obtain our first experience of nuclear power from their operation.

The longer-term objective is to build nuclear power stations which will produce power at a cost not very different from a coal-fired station. For this to be worth while we must have adequate uranium-ore reserves in sight to fuel our nuclear power stations for many centuries. Uranium is not a scarce element—it is twenty times more abundant than silver and one-twelfth as abundant as lead, and there are many million tons in the earth's crust in a dispersed form. It is present in gold ores, shales, granite, and many other minerals in varied proportions up to about 1 per cent, whilst there are limited deposits of much more concentrated uranium.

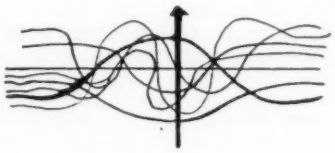
The first major objective is to find economical methods of extracting the low-grade uranium from its ores. The second is to develop nuclear power units which will burn a much higher proportion of the uranium than was customary in the wartime piles. For this we have to develop a new type of atomic pile known as the "breeder pile," because it breeds secondary fuel as fast or faster than it burns the primary fuel, uranium 235. This secondary fuel can be bred from the more abundant uranium 238 or from thorium. Breeder piles are being studied at Harwell, and we hope to build one in due course. One is being built in the United States, and another type is being studied. These piles present difficult technical problems and may take a considerable time to develop into reliable power units. Their operation involves also difficult chemical engineering operations in the separation of the secondary fuel from the primary fuel.

There may be other and less ambitious routes to nuclear power. It may be possible to use piles which are not very different in principle from those which have been built for the production of plutonium.

Piles of this type would be fuelled by natural uranium. They would have to be designed for high-temperature operation, and arrangements would have to be made to transfer their heat to a boiler or turbine. This system would make a partial use of the breeding principle, but would be very unlikely to make as efficient use of uranium as the true breeder. If we could achieve a 1 per cent utilization of the uranium, the system would have a chance of economic success. If, for example, we used for such a power system ore containing 1 per cent of uranium, a simple calculation shows that we should have to dig one ton of ore instead of three hundred tons of coal required for conventional power stations. The difference in mining costs would therefore be available to pay for the additional chemical engineering costs of uranium extraction and metal-making, and for the additional costs of the nuclear boiler. We do not yet know whether this would be sufficient; neither do we know whether we can burn as much as 1 per cent of the uranium in such piles. The feasibility of the system is, however, being investigated.

One major difficulty bedevils the work of the nuclear engineer—the radioactivity which is produced along with the development of heat.

There is, of course, a great deal of radioactivity already present in the world. There are many million tons of low-grade uranium and many tons of radium in the outer layers of the earth's crust. Uranium is present in all river waters, and its daughter-product radium is present with much the same activity. There is also a good deal of radioactive potassium in the world and some in our blood; we are also continually subjected to bombardment by the cosmic rays; whilst the operations of mass radiography, dentistry, and shoe-fitting add very appreciably to nature's irradiation. A little radioactivity, therefore, does no harm; indeed, the radioactive Spa waters have long been recommended by the medical profession! However, radioactivity taken in excess is undoubtedly harmful, and the nuclear engineer has to take account of health hazards in designing his nuclear boilers and chemical plants, and this slows down development and increases costs. More important still, a world run on nuclear power would increase substantially the amount of radioactive materials in the world, and their safe disposal or storage may prove to be costly and difficult.



I think it is generally agreed that the development of nuclear energy from uranium is more difficult than had been supposed in the first flush of postwar enthusiasm. We shall not be able to predict its future with any certainty until we have built experimental power-producers and obtained experience by their operation for some years. We shall require at least the next decade for this phase.

POSSIBILITY OF ENERGY FROM THE LIGHT ELEMENTS

I have not discussed the possibility of the release of energy from the light elements. So long ago as 1920, Eddington[3] pointed out that the sun's radiation could be maintained at its present level for a thousand million years by the transformation of 10 per cent of its hydrogen into helium. The experimental investigations on the transmutations of the light elements by protons carried out between 1932 and 1939 led to the suggestion by Bethe, Gamow, and others that this conversion of hydrogen to helium would occur in the central region of the sun where the temperature is about twenty million degrees. The conversion was believed to take place through a cycle of four nuclear reactions starting with the conversion of carbon 12 to carbon 13, the cycle being completed by the conversion of nitrogen 15 to carbon 12 again, with the production of helium. Other, and more direct, cycles are now known to be possible, and these probably occur in some stars. For example, if deuterium is formed by reactions between hydrogen nuclei, then reactions between deuterium nuclei will produce tritium and tritium will react with deuterium to produce helium. These reactions will start at substantially lower temperatures than are re-

[3] *British Association Report*, 1920, p. 45.

quired for the carbon cycle. It may well be that means will one day be found of producing suitable temperatures in the laboratory and so releasing energy peacefully from the light elements. The difficulties, however, appear to be formidable.

For the present, the attention of the world has been focused on the destructive possibilities of reactions between the light elements. In particular, suggestions have been made that these reactions would enable all life on this planet to be destroyed by a single event.[4] I believe that these statements are greatly exaggerated. If this project were unfortunately found to be possible, we should probably have to fear most an extension of the areas of damage by fire and blast which became only too familiar after the Japanese explosions.

THE IMPORTANCE OF ACHIEVING INTERNATIONAL CONTROL OF ATOMIC ENERGY

This, however, is quite serious enough and emphasizes once again the importance to the world of achieving on a secure basis the international control of atomic energy. This, in turn, depends almost entirely on improvements in the political climate of the world. There is little we can do as scientists to help in this matter, save to provide our government with the necessary technical advice and to help to maintain an informed public opinion in our country. Only by full knowledge and understanding can we avoid "fear of the atom" leading to the unbalanced judgments which might endanger both our freedom and our safety.

Looking back over the last half-century, one is impressed by the inevitability of this development of our knowledge and of our increasing command over the forces of nature. This success of the physical sciences, which is only one side of the story, presents a multiple challenge. To the natural scientist, it presents a challenge to understand the nature of the new forces—the forces of nuclear energy—and at present we stand on the threshold of exciting new advances in physics; it presents the engineer with a challenge to turn these forces to beneficial uses; most of all it presents our political leaders with a challenge to develop that political cooperation which is needed to meet this and other needs of our changing world. We can, I think, see these developments taking shape today.

[4] See James Arnold, "The Hydrogen-Cobalt Bomb," *Bulletin*, VI (October 1950), 290-92.

The Atomic Age and the Belief in Progress

THE atomic age has finally exploded one of the controlling assumptions of Western civilization—belief in the inevitability of progress. This is the conclusion reached by Mr. Michael Amrine, in an article "What the Atom Age Has Done to Us" (*New York Times* Magazine, August 6).

While pointing out that this belief has never been accepted by the majority of human beings (it is not endorsed by Asiatic religions, by Judaism, nor by the Catholic Church), Mr. Amrine stresses the great part it has played in Western democratic thought since the 17th century. "It was a main ingredient of the Industrial Revolution, in the establishment of the British Empire—and even in the revolution of Lenin."

According to Mr. Amrine: "This belief—as expressed, for instance, in the 'happy ending'—is intense in America; in Britain men for centuries have felt that law and order would always 'muddle through somehow'; it has been a thread of cohesion in European culture before and after Rousseau's phrase, 'the infinite perfectibility of the human race.' The era of happy faith in Man's reason may be discerned as having begun with Copernicus and ended with Einstein.

"A multitude of poets and philosophers have been saying gloomy things about progress with increasing insistence during the last fifty years, from Oswald Spengler through T. S. Eliot. Before the bomb, Eliot, poet of 'The Wasteland,' wrote:

The endless cycle of idea and action
Endless invention, endless experiment,
Brings knowledge of motion, but not of stillness;
Knowledge of speech, but not of silence. . . .
All our knowledge brings us nearer to our ignorance,
All our ignorance brings us nearer to death. . . .
Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?

"Thirty years ago, Millikan, discussing the happy things to come out of the laboratory, put the question something like this: 'Who can doubt that the London cab driver of today is a far happier man than the ignorant London cabby of 100 years ago?' If Millikan were to ask that question in a community forum today, many ministers, social workers, and psychiatrists—and very likely a cab driver or two—would get up and say, 'I wonder.'

"There is a growing suspicion tha our grandfathers may not have live so long as we do but lived better. They did not have automatic toasters, but they had better bread; they did not have television, but the shadow pictures that grandfather made with his hands by the light of the fireplace may have been more satisfying to his family. This is not facetious.

"Some years before the bomb Dr. Einstein asked a group of students: 'Why does this magnificent applied science, which saves work and makes life easier, bring us so little happiness?' It was a time when most Americans still thought applied science was the main source of happiness.

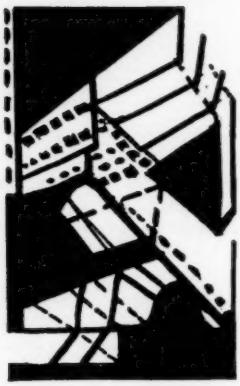
"With his usual lucidity in these matters, Dr. Einstein answered his own question: 'Because we have not yet learned how to make sensible use of it. It is not enough that you should understand about applied science in order that your work may increase man's blessings. Concern for the man himself and his fate must always form the chief interest of all technical endeavors. Never forget this is the midst of your diagrams and equations.'

"The basic belief of Western Man that his material progress was inevitable—and irreversible—was perhaps expressed in the phrase still thrown at those who want to slow down our material civilization to keep pace with our social ability. 'Ah, but you can't turn back the clock,' they say. As a matter of fact, nothing is easier than to turn back a clock, as the nearest 10-year-old child can show you. Our machines do what we tell them to do, and our whole civilization is no more secure than ourselves.

"The Nazis built better roads than the Romans, and German science once led the world. But they turned the clock of civilization back a thousand years.

"What we were slow to learn from Hitler we must be swift to learn from Hiroshima; it is a small world—or a large one—only as men are great and petty. Man is more than intelligence and civilization is more than knowledge."

CONTROL OF RADIATION HAZARDS IN THE U. S. ATOMIC ENERGY PROGRAM



Eighth Semiannual Report of the USAEC: Part I

Summarized by George V. LeRoy, M.D.

THE ACHIEVEMENTS of the atomic energy program in the United States are remarkable. Depending on one's point of view, the development of the atomic bomb is commendable or deplorable. The peaceful application of atomic energy in medicine and research is one of the real beneficial results of World War II. In the public mind, these spectacular activities have overshadowed the unusual safety record of the program. The early workers with X-rays and radioactive material suffered countless injuries, and many died before adequate safety precautions were developed during the 1920's and 1930's. Since 1942, there have been only fifteen casualties in the atomic energy project, and only two of these died. During this time, thousands of workers have participated in the production of radioactive material equivalent to millions of pounds of radium. The major portion of the Eighth Semiannual Report of the U.S. Atomic Energy Commission is an account of the means by which this remarkable record was achieved.

Nuclear radiations are inseparable from the atomic energy program; actually, they are manifestations of atomic energy. At the outset of the program, some experts thought that it would be impossible adequately to protect personnel from the powerful radiations of the reactors. The development of satisfactory shielding and remotely controlled devices to operate the reactors and chemical processors has been a major problem of industrial design and construction which has been solved. The waste products, stack gasses and coolants of atomic energy plants, presented other problems which also were solved, so that the environments of these plants have not been harmed. Since 1946, 11,000 shipments of radioisotopes have been delivered to off-project users by the Isotopes Division at Oak Ridge. So far as is known, no one has been injured in the operation of this "Atomic Apothecary."

Testifying before the Senate's Special Committee on Atomic Energy after the war, Dr. Vannevar Bush termed the atomic energy program "by long odds the most dangerous manufacturing process in which men have ever engaged." In spite of this, hazard pay is not necessary in the plants and laboratories, and life insurance is available to workers at rates comparable to those in other industries.

The Report presents in scant detail the history of the development of the "radiation safety" organization which made these results possible. The first phase began in 1921-22 when radiologists and radium therapists published radiation protection measures. In the United States, the National Committee on Radiation Protection was formed in 1928. This group continually revises the accepted limits of exposure for gamma and X-ray radiation and for quantities of radium deposited in the body. When the first nuclear reactor was built at the University of Chicago in 1942, radiologists and radiation physicists established a Health Physics division to assess the radiation hazards and to plan the methods for its control. By the time the first reactor was operating, there were ten health physicists on the staff of the Metallurgical Laboratory. These men established maximum exposures, developed new instruments, studied the construction and processing problems and made the essential measurements. When the first Oak Ridge pile was built, Health Physics was a well established discipline with a training doctrine and a successful operational plan. At the present time there are 828 health physics employees, 333 of whom are professionally trained. The entire health physics program is now the responsibility of the Biophysics Branch of the Division of Biology and Medicine.

The success of the radiation safety program of the Atomic Energy Commission can not be measured adequately by the total number of known casualties. Radiation injury may be chronic and insidious, and serious late effects can occur, as was the case with the early radium and X-ray workers. The Atomic Energy Commission is reasonably certain that chronic radiation injury will not be found in their employees. The goal of the radiation safety program is to insure that no worker shall receive more than 15 r per year, or 0.3 r per week. According to the Report, the average exposure of all workers at Hanford and Oak Ridge in 1949 was 0.2 r and 0.19 r, respectively. The average of the ten highest exposures reported was 4.2 r per year. This is a remarkable record, and one which could not be duplicated by any commercial radium concern, or by many industrial or medical radiological departments. The Manhattan Engineer District and the Atomic Energy Commission have every right to be proud of this achievement.

It is unfortunate that it is customary to prepare governmental reports in an impersonal style. In the Report the success of the radiation safety program appears to be related closely to the ingenious safety devices that have been developed, and pictures of which are presented. Actually, the program is a monument to a small group of radiologists and radiation physicists whose devotion to duty, and to their personal convictions was exceptional. These men refused to tolerate any compromise with the standards of maximum permissible exposure which they helped to develop over a period of years. As a consequence of this attitude the cost of the atomic energy program has been very high in dollars; but very low in human lives. It is regrettable that the Report did not include the names of these leaders.

A summary of Part II of the AEC Eighth Semiannual Report appeared in the October issue of the *Bulletin*.

ACADEMIC FREEDOM ON TRIAL AT THE UNIVERSITY OF CALIFORNIA

Geoffrey Chew

The issues behind the struggle between the Board of Regents and the faculty at the University of California are described in the following article by a former member of the University of California faculty. Professor Chew is now teaching in the Physics Department at the University of Illinois.

ON THE twenty-fifth of August of this year, in a meeting at Berkeley, the Board of Regents of the University of California dismissed twenty-six members of the faculty for failure to sign a contract of employment—a contract which had been accepted by approximately 1,500 of their colleagues. This action has been protested strongly throughout American academic circles. Two national professional societies, Psychological and Mathematical, have issued statements discouraging members from accepting jobs at California. The faculties of many independent universities, large and small, have sent messages deploring the regents' action; and the Committee on Freedom and Tenure of the American Association of University Professors has been asked to make an investigation. At California itself faculty morale is at an all-time low. Eleven resignations have already been received as a result of the action, and the number of professors looking for other jobs is known to be considerable. The Psychology Department has been practically wiped out, the English Department badly damaged, and, in the university as a whole, forty-three courses have been dropped for lack of teachers.

The immediate reason for the widespread repercussions from the regents' action is centered on the issue of tenure and the right of a faculty to set up its own standards of membership. Academic tenure is the assurance given the university teacher that after he has established his capability and honesty as a scholar and reached the rank of associate professor he can no longer be fired except for serious personal misconduct. It is widely regarded as the cornerstone of academic freedom, since its possessor is freed from outside pressure. At many universities tenure is specifically written into contracts. At California this was not true, but many years of practice had apparently established the tradition firmly. In those rare cases in which a tenure professor was accused of misconduct, a standing faculty committee made an investigation of the charges, and its recommendations were followed by the regents.

The retention of the whole group of twenty-six faculty members mentioned above, which included many of tenure rank, was strongly endorsed by the faculty committee which investigated the case. Therefore, in rejecting the faculty committee's recommendations and in firing these people, the regents were violating the traditions of tenure and the right of a faculty to be its own judge. It is not surprising that the academic world was disturbed. This was no backwoods college. This was the University of California, our leading educational institution west of the Mississippi.

A great many of the people who are most worried about the developments at California prefer not to discuss the particular reasons for which the regents decided to fire a number of teachers. The chief issue in the minds of these people is that the regents did disregard certain faculty prerogatives which are essential to academic freedom; and the passage of time may indeed show that this was the chief significance of the action. Nevertheless, this writer judges it a mistake to ignore the background of events leading up to the August climax, for something can perhaps be learned which may help steer other universities from the same fate.

Working with a group of professors on the California faculty, George R. Stewart has written a book called *The Year of the Oath*[1] which presents the faculty case while describing the first year of the struggle between the regents and the professors. This article will give a summary of Stewart's account with the addition of facts pertaining to the most recent action of the regents. The present writer's interpretation of the situation is slightly different from that of Stewart, since at the time the book was written, Stewart assumed that the regents would accept the recommendation of the Faculty Committee on Privilege and Tenure.

BACKGROUND OF THE CONTROVERSY

To understand the controversy which started at the end of the Spring semester of 1949, it is necessary to go at least as far back as 1940. Stalin was at that time allied with Hitler; the Russo-Finnish war was fresh in the minds of everyone; and anti-communist feeling ran high. Consequently, when the California regents fired a teaching assistant for being a Communist and announced a general policy of communist exclusion from the faculty, no protests were publicly made. The faculty was not asked its opinion on the matter, and this particular dismissal, even if not the general principle, probably found approval among the faculty. It is significant that anti-communist policies

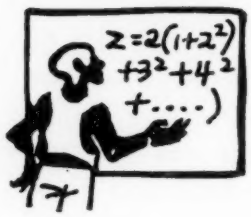
[1] New York: Doubleday and Company, 1950.

were initiated in other state universities at this time, also without faculty objection, and in a few cases the policy was implemented in part with a loyalty oath. An understanding of why professors did not object in 1940 could only be gained by re-creating the mood of that period. A little light is shed by the fact that at least one of these oaths does not refer specifically to the Communist party, but only to organizations advocating the violent overthrow of the government. Such wording in 1940 suggested Nazis and Fascists more than Communists.

In any case, very little attention was paid to the menace of communism once Germany invaded Russia, and, at least at the University of California, the faculty forgot all about the anti-communist policy. It was reminded of it in May of 1949 when the regents announced that the policy was to be revitalized with a special loyalty oath for all university employees. The idea of doing this had started a few months earlier when the president of the university was informed by his representative at the state legislature that some action was required to dramatize the political purity of the faculty. Along with a great many other institutions, the university had been criticized by the state Un-American Activities Committee, and it was felt that the legislature was in a mood to alter the state constitution (which protects the university from outside interference). Together with all other state employees, all members of the faculty were taking an annual oath to uphold the California constitution, but the university administration felt that an addition to the oath, just for university employees, specifically disavowing membership in the Communist party, might placate the legislators. There is every reason to believe that the president had confidence in his faculty and was acting to protect it from outside encroachments. Unfortunately, he did not take the faculty into his confidence; perhaps he could not have done so without losing the desired effect. Before announcing the oath, the president consulted the regents. Most were unimpressed by it as a practical means for carrying out the anti-communist policy. However, if the oath would help preserve the university autonomy, the regents did not see how it could do any harm.

WHY THE FACULTY OBJECTED TO THE OATH

Up to this point it seems to be true that no one, either in the administration or on the Board of Regents, suspected that there were to be objections from the faculty. Why should there be any? There were certainly no professors who would admit membership in the Communist party, and the faculty had never objected to the regents' policy, which, after all, was the real means of excluding communist teachers. Also several other state universities had loyalty oaths, dating back to 1940. So we come to the difficult question: Why did the California faculty make such a fuss?



In the first place not all the faculty did make a fuss. In the second place, the resentment on the part of many was not deep-rooted. The text of the oath was announced through the newspapers just as faculty members were about to leave the campus for their various summer destinations. This gave the impression that the regents were trying to put something over while the faculty was disorganized and defenseless. Also the wording of the original special oath was crude, having been composed hastily. This upset the semanticists. Many more were offended by the implication of distrust on the regents' part and the singling out of the university as the only state institution for which the special oath would be required. Many of the objections were based on reasons such as these; less than half of the faculty objected to the oath on the more "fundamental" grounds discussed below.

In his book, Stewart lists eight general reasons for objecting to the oath, without attempting to give an order of importance. In this article, the list will be simplified by omitting some reasons, which were not longer important after the first few months of controversy, and by grouping together some of the others.

A very eloquent, although small, group of objectors was made up of former Europeans who had actually lived under dictatorial regimes sometime during the last twenty or thirty years. These people, none of whom have any use for communism, felt an uncomfortable similarity between the imposition of the oath and the encroachments on academic freedom which they had witnessed in Europe. They felt that the oath was an indication of fascist tendencies which they fear are now growing in America. Ironically, the resistance of this group was solidified by the statements and actions of certain regents who had nothing to do with the original introduction of the oath.

A second group believed that the oath constituted a political test for faculty membership. In other words these people did not accept the principle that mere membership in the Communist party should disqualify a man from the teaching profession. This position has received considerable attention in newspapers and magazines since 1946. Adherents have been steadily decreasing in number, and practically all those who are left are within the academic profession itself. Two years ago sentiment was sufficiently strong that the executive committee of the American Association of University Professors made an official statement condemning the practice of blanket communist exclusion. It is doubtful whether such a statement would again be passed today. One may well wonder what good the teachers at California who were "fundamentalists" on this question thought they could do by opposing an oath, when they had been living for years uncomplainingly with a university policy of communist exclusion. I think the answer is simply that there had never before been such a clear-cut opportunity to protest. Refusal to sign the oath was a protest against the university policy. Many had not even been aware of the policy, and those who were had never had the chance to express their opinion. The regents had initiated the policy without consulting the faculty. Now they were, in effect, asking the faculty to endorse it. This, at least, was the point of view of the "fundamentalists," who were by no means in a majority.

A third reason for resistance had less to do with the original oath than with the subsequent actions of certain regents. It was easy to interpret these actions, as we shall see, in terms of the regents' desire to gain a more direct control of university affairs and limit certain of the traditional faculty prerogatives. As time went on, this issue became clearer and the oath itself became primarily a symbol of the struggle for power. In this connection, it is worth recalling a fact which, while significant, has rarely been pointed out. One or two of the most eminent and liberal professors made the statement early in the fight that never, under any circumstances, would they sign that oath. That meant, that either the oath had to be

withdrawn or these men would have to leave. Firing them would be a violation of tenure, which to the faculty as a whole was a far greater evil than the special oath; but so long as even one single man held out, the impasse was inevitable. The violation of tenure was to be avoided at all costs, and it seemed to some that the best way to achieve the withdrawal of the oath was to have a large group of holdouts. Thus, many teachers, who were not really "bitter-enders," refused to sign as a matter of strategy, in order to guarantee the tenure principle. They could not admit this publicly, of course, and some did not even admit it to themselves; and, as time went on, self-respect made it more and more difficult for them to sign. The motive of solidarity thus became inextricably mixed up with fundamental motives.

A final reason had to do with the publicity which the controversy was receiving. California professors suddenly found themselves the champions of academic freedom. Realizing that benefit to other universities might result from resistance to the oath, some were reluctant to give up without a fight even if this had been the best course of action if only the future of the University of California were considered.

THE DECISION OF THE ACADEMIC SENATE

At the meeting of the Academic Senate in June of 1949, the special oath was vigorously discussed. Objection to it by those present was nearly unanimous, although the reasons were not. The upshot of the meeting was an instruction to the Advisory Committee of the Senate to confer with the regents for the purpose of revising the oath to remove objectionable features. Just what the objectionable features were was not stated in the instructions to the committee because the Senate could never have agreed on them. It was hoped, in a vague way, that the entire addition to the oath would be deleted.

The exact course of the subsequent negotiations between the Board of Regents and the Advisory Committee is somewhat obscure, the two sides later giving slightly different versions. The Advisory Committee seems not to have been composed of "fundamental" objectors, and while they tried to get the "political test" aspect removed from the oath, they evidently did not vigorously represent the objections of the fundamentalists. The result was a revised special oath, which was written in better English but which contained exactly the same content as the original.

THE REGENTS' POSITION

Let us now take a look at the regents' position. After all the publicity given the special oath, the regents were justified in not wanting to withdraw it outright. That would have placed the university in a worse position with respect to the legislature and the public. On the other hand, they could have agreed to a wording proposed by the Advisory Committee which avoided making the oath a political test while giving every impression of its being a disavowal of Communist party membership. Some of the professors would not have liked this, but they would have accepted it. The majority would have had no objection at all. The fact is that the regents did not do this, so we come to the second important "why?".

Stewart lists six possible reasons to explain the stubborn position of the regents. Only one of the twenty-four regents is known to be honestly fanatic on the subject of communism, and he would not compromise in any matter concerning it, no matter what other considerations might exist. Genuine concern about possible Communists on the faculty, however, was certainly not a factor in the actions of the overwhelming majority of the board. A second possible reason might stem from a reluctance to back down publicly before faculty pressure. This motive ceased to exist after the many compromises offered by the faculty, so we must look to Stewart's other hypothetical reasons. These all have to do with local politics, the importance of which was shown by the sharp cleavage in the board on every significant vote taken after the faculty had made known its opposition. In order to emphasize the cleavage the known *facts* about the controversy up to the present will be stated before the possible political motives of the various regents are considered.

THE SPLIT WITHIN THE BOARD OF REGENTS

The Academic Senate continued unsuccessfully, through the Fall and early Winter, its attempts to have the oath modified. On February 24, 1950, a group of regents who constituted a majority at the meeting of the board that day, voted to fire all faculty members who did not sign by April 30. From that day on it is legitimate to distinguish between a pro-faculty group and an anti-faculty group of regents, since only two of the total of twenty-four changed their votes, from what they were on February 24, during the following six months. (The board as presently constituted has eleven "pro-faculty" members and thirteen "anti-faculty" members with one of the two waverers in each group. The president of the university and the Governor of California are the leaders of the pro-faculty regents, while a San Francisco attorney leads the anti-faculty faction.)

The great majority of the faculty gave up after the ultimatum of February 24 and signed the oath; but about 20 per cent continued to hold out, so the threat of tenure violation remained. The more conservative professors then snatched at an opportunity to make peace by a maneuver. The leader of the anti-faculty regents, in an unofficial message, had implied that the special oath would be withdrawn if the faculty would only "adopt a resolution in plain English unequivocally endorsing the policy excluding Communists." The faculty was split on this question and knew it; but the majority managed to avoid an open break by putting the question to a secret mail ballot and suppressing discussion. The only argument heard was, "We must save the university." Taken under terrific pressure, the results of the vote were: 1,025 in favor of the policy, 268 opposed to it. It was assumed that the controversy was over, the faculty having yielded on a more significant point than the oath itself.

The next meeting of the regents became known in faculty circles as the "Great Double-Cross." Despite the faculty adoption of anti-communist policy in resolution form, only one of the anti-faculty regents switched his vote. The order to "sign or get out" still stood. The faculty, as a body, rose up in indignation but was impotent. The majority could do nothing but try to persuade their dwindling holdouts to give up. One of the difficulties, as mentioned above, was the question of pride. This could be circumvented to a large extent by having the non-communist statement transferred from an oath to the regular contract. Those who had sworn never to sign the oath would thus be given a graceful way out. The regents, anti-faculty and pro-faculty, agreed to this formal switch almost unanimously. The basic impasse still remained, however. What should be done with those die-

hards who refused even to sign contracts containing the non-communist clause? In the resolution effecting the procedural change, the regents dodged the issue by including an ambiguous statement as to how such people should be handled. They were to be heard by the Faculty Committee on Privilege and Tenure which would then make recommendations to the board.

The inevitable happened. A group of fifty-two refused to sign and were given hearings by the faculty committee. The committee, although finding no evidence of communism, felt that a blanket recommendation of the entire group would be regarded as a "white-wash" and stand no chance of acceptance. Some would have to be thrown overboard, so they chose six whom they considered to have been less cooperative than the rest. No recommendation for retention was made in these six cases, but retention of the remainder was strongly urged. However, the regents continued to vote *en bloc*, and the anti-faculty wing maintained its bare majority. Thus on August 24, the faculty recommendation was rejected. Only twenty-six holdouts were left at this time, the remainder have resigned or signed, but the violation of tenure was just as clear as if there had been a thousand.

(There had been a poorly attended regents' meeting on July 27, at which the pro-faculty group was in a majority. At this meeting, the regents voted, 10 to 9, to accept the faculty recommendation and hire these twenty-six. However, at the next meeting, this action was reversed by a vote of 12 to 10. This reversal on the part of the Board of Regents is the subject of the current law suit for breach of contract against the University of California by fifteen of those fired.)

MOTIVES OF THE REGENTS

The extremely consistent voting record of the regents as well as the proceedings of their meetings make it obvious that primarily they were divided into two groups struggling against each other, with the faculty as the football. Stewart points out that a drive by the anti-faculty regents to take over direct control of the university would necessarily run into the president of the university. One element of the struggle, in all probability, therefore, was the attempt to force the president to resign by refusing to let him get out of the embarrassing position with respect to his faculty, in which he had placed himself. Sectionalism played a part, since the president has long been an obstacle to certain residents of Southern California who have wished to have the Los Angeles branch of the university made an entirely separate institution. Regents representing this point of view may well have jumped at the chance to depose or at least embarrass the president. Finally, the line-up of regents is partly to be interpreted in terms of the struggle between liberal and conservative wings of the state Republican party. The Governor took the side of the faculty, and his political opponents went in on the other side, no doubt hoping to embarrass him on a touchy issue.

To quote Stewart: "In view of all the extraneous issues that were drawn into the oath controversy, the members of the faculty can scarcely be blamed in thinking that the university was being made a mere pawn and that self-seeking careerists were driving ahead ruthlessly against Academic Freedom."

There can be no doubt that the split in the Board of Regents was an essential ingredient to keep the pot boiling until the final disaster. The faculty did not realize until it was too late that half the board could not be swayed by any arguments or weapons which normally would be effective at an institution anxious to maintain its reputation for scholastic excellency and academic freedom. This half was and is prepared to have a large fraction of the faculty resign and the school blacklisted by all existing scholastic and professional organizations. It is not a question of malicious intent; it is simply a question of values. These regents just don't think that such considerations are of overwhelming importance. The faculty never had any effective weapons to fight its battle, and delay in recognizing its own helplessness brought on the disaster.

What is the moral of this very sad story? One obvious conclusion is that people who do not understand what a university is should not be elected or appointed to the boards governing universities. The anti-faculty regents at California conceive of the institution as they would a high school, with the entire staff to be hired and fired like any employees. They presumably are honest in their desire to serve the best interests of the university and the state. They just don't know what the interests of a university are.

A second conclusion is that the relative duties and rights of faculty, administration, and governing board should be more clearly defined. A legal basis for tenure, for example, would have probably averted the California disaster. In general, the right of a faculty to be its own judge ought to be more firmly established.

If the faculties of other American universities are alerted to these necessities, the tragedy which befell the University of California may perhaps prove of service to the cause of academic freedom in this country. This is the only hope one may find in the present sad and humiliating situation.

CIVIL DEFENSE: COMMUNITY PROBLEMS AND THE NSRB PLAN

Frank P. Zeidler

In this article the mayor of Milwaukee discusses the recent plan for U.S. civil defense issued by the National Security Resources Board, and the results of the tests held in Chicago in September. A previous article by Mayor Zeidler on municipal organization for civil defense appeared in the August-September issue of the Bulletin.

HOW ready are cities for ABC warfare — atomic, biological, and chemical warfare? Two civil defense meetings and a new publication have served to point out our strengths and our weaknesses.

The new publication, *United States Civil Defense*[1] (Document 128 of the National Security Resources Board) has been closely studied by local civil defense leaders all over the United States. Published shortly before the Chicago civil defense exercises of September 25-29, it figured in the discussions at these exercises and at the civil defense meeting of the United States Conference of Mayors in Washington on October 5 and 6.

The first impression gained by most civil defense directors with whom I have spoken is that *United States Civil Defense* is principally a restatement of the Hopley report. This commentary, however, far from being an adverse criticism of *United States Civil Defense* is in reality a compliment to the excellence of the Hopley report.

However, close inspection of the volume reveals that it has gone beyond the Hopley report in that it hints at certain federal policies which are now in process of development. These policies were revealed at the meeting of the mayors by several representatives of the National Security Resources Board.

A principal spokesman on this subject was James J. Wadsworth, Acting Civil Defense Director. Wadsworth stated that the federal government would be responsible for research developments; for setting standards of protective construction; for developing training courses, manuals, and aids; for setting communication standards and procedures, and for financing a part thereof down to state warning systems; for stockpiling medical and surgical supplies and aiding Red Cross blood storage; for developing radiological and bacteriological teams and mobile laboratories.

Wadsworth said that the federal government would not be financially able to pay for large amounts of equipment of the type normally used by cities to augment present supplies, for personal equipment, or for salaries of local civil defense workers.

The chief value of the book lies in the fact that it shows many cities how to get started on their programs, how to inventory their resources, and how to collect materials and men. It does not provide details on the actual operation of a civil defense organization in the field.

The document does not tell how to finance a program, and it does not deal directly with the problem of metropolitan organizations—city and suburban integration.

Up to this date, most cities have waited for the publication of *United States Civil Defense* to point an easy way to the organization of an effective civil defense program. The Chicago defense tests showed that there is no easy answer to this question.

The many committees which worked on the hypothetical test of three atom bomb bursts produced an immense amount of analytical work and revealed some major difficulties in operations.

The committees assigned to special tasks had to evaluate the hypothetical disaster and their resources for meeting it. Then they had to plan the proper disposition of these resources and forces.

It is natural that some defects in judgment should have appeared, such as in the operation of a warning system, in the estimate of the psychological ability of people to respond to the disasters, in the composition, disposition, and operation of certain forces, such as medical teams and rescue squads.

The principal value of the exercise, however, must not be overlooked. The Chicago exercise illustrated the immense amount of detailed work that must be accomplished in order to prepare an effective plan and to put it into operation quickly.

There is no escape from detailed study, from discussing and coordinating the many items involved, and from making pioneer judgments on civil defense in each local community. Every community presents a problem different from every other community. Generalized solutions to specific civil defense problems set down in the Hopley report and in *United States Civil Defense* must be adapted to fit local capacities.

As a result of the Chicago exercise and of the meeting of mayors in Washington, most local officials went away with the realization that they must solve their own problems.

* * *

Even the best organized cities reveal great civil defense weaknesses at the present time. The majority of them possess organizational charts, but the actual organizations are non-existent except for a few top persons.

The psychological reactions of people and their actions under various pressures are but dimly understood. The ways of operating component parts of the civil defense organization are the subject of much debate. The struc-

(Continued on page 341)

[1] Available from U.S. Government Printing Office, Washington 25, D.C. Price is 25 cents.

CIVIL DEFENSE NEWS

THE NATIONAL CIVIL DEFENSE PLAN

The United States Civil Defense plan[1] prepared by the National Security Resources Board, approved by the President, and sent to Congress, has now been read and considered by the mayors of our leading cities and all those directing the local civil defense programs. They have found that, in general, it is simply a scissors-and-paste job on the Hopley report[2] and that the situation is little advanced beyond that existing before the NSRB began its consideration of the problem.[3] The responsibility for civil defense planning and organization rests with the local governments. It is apparent that national civil defense planning is still in the paper stage. In fact, many state and city plans are developed quite beyond the point where the NSRB report will be useful[4], and such a report would appear to most defense organizers to be perhaps six months too late. All the vital questions of (*a*) magnitude of preparations necessary, (*b*) timing of plans, (*c*) cost and exact methods of financing, and (*d*) the urgency of the plans for defense against various types of weapons remain unanswered. It was for the answers to such questions that our local civil defense leaders looked to our national planners.

James M. Landis, Director of the federal Office of Civil Defense in World War II, has stated that "the new federal plan for civil defense seems . . . to be more like a plan for World War II than for World War III, a plan for TNT bombs rather than for A-bombs, so far as its administrative aspects are concerned. . . . The possibility of A-bomb attacks makes it much more necessary to set up over-all command of civil defense resources. . . . A-bombing will require much inter-state action. . . . Congress should act . . . to establish an operational Civil Defense Administration with broader powers than those envisaged in the legislation suggested by President Truman."

[1] See *Bulletin*, VI (October, 1950), 315.

[2] Summarized in the *Bulletin*, V (April, 1949), 111, 126, and discussed by Horatio Bond in "Military and Civil Confusion about Civil Defense," *Bulletin*, V (November, 1949), 295-97, 314. See also Elwyn A. Mauck, "History of Civil Defense in the United States," *Bulletin*, VI (August-September, 1950), 269.

[3] See Mayor Zeidler's discussion of the plan, pages 337 and 341 of this issue.

[4] This was brought out at the Conference of Mayors meeting (see below) and admitted by the Acting Director of the Civil Defense Office at the New York meeting of the Eastern Conference in September (see below).

MAYORS CRITICIZE VAGUENESS OF FEDERAL PLAN

The mayors of the nation's cities met in Washington early in October in what was described by its chairman, Mayor David F. Lawrence of Pittsburgh, as an "emergency meeting." It was called, he said, in view of "the need for intelligent guidance" in civil defense planning. At this meeting Mayor Robinson (San Francisco) voiced the general opinion of the mayors when he stated: "We feel that civil defense is the step-child of the government" and demanded to know why the government had not decided how much it would spend on civil defense so that states and municipalities could make their supplemental appropriations.

Mayor Robinson also questioned the meaning of the statement in the U. S. Civil Defense plan that the government would supply "some equipment." Such wording, which is characteristic of the report, leaves much doubt as to procedural details in the minds of local planners.

W. Stuart Symington, chairman of the NSRB, answered the mayors by saying only that legislation now introduced should provide the necessary federal powers and that sound estimates of needed outlays would be ready in time. He also stated: "Planning is the most important thing. Nobody could start spending heavy money in these next two months because a report couldn't be gotten together and there couldn't be a plan in that time."

However, the local governments whose plans seem to be considerably beyond that stage envisaged by Mr. Symington are pushing ahead with their programs regardless of what federal aid may be forthcoming.

Members of the staff of James J. Wadsworth, Acting Director of the Civilian Defense Office of the NSRB, advised states and municipalities to make detailed surveys and estimates of their defense requirements. He stated that federal funds, when they did become available, would be allocated largely on the basis of these findings.

PROGRESS IN STATE LEGISLATION

It was announced by the NSRB that twenty states now had new civil defense laws, fourteen states had laws based on World War II legislation, and fourteen states had civil defense agencies by executive order.

Nine states were reported to have new current one-year civil defense appropriations as listed below: California, $400,000; New York, $100,000; Massachusetts, $150,000; District of Columbia, $100,000; Connecticut, $75,000 (one-half year); Louisiana, $50,000; Minnesota, $50,000; Colorado, $25,000; North Dakota, $10,000.

ACTIVITIES OF THE NSRB CIVIL DEFENSE OFFICE

The Civilian Defense Office will issue about thirty basic information manuals before June, 1951. One federal civil defense college is planned for the near future. Two types of courses, one for those who supervise top officials and a longer course for full-time administrators and their staffs will be offered. If funds are authorized, the first of these courses will be under way in February, 1951.

The Civil Defense Office of the NSRB has issued NSRB Document 128/1 to the nation's governors and mayors. This document discusses patterns of civil defense activity in typical American cities. Associated with this document is a set of maps of 250 to 260 critical atomic bomb target areas in the country (140 "primary" targets) showing mobile support routes and suggested details of civil defense planning.

The maps are to be kept confidential by the governors and mayors, each of whom is receiving maps related only to areas under his jurisdiction.

The Acting Director of the Civil Defense Office told the state civilian defense directors early in October that President Truman has drafted an executive order to establish a federal Civil Defense Administration, but it has not been made public.

The NSRB has created a general committee and five task groups to conduct an air transport mobilization survey. Delos W. Rentzel, chairman of the Civil Aeronautics Board, has been appointed general chairman. A general survey of the mobilization and operation of air transport and related industries in case of an emergency will be undertaken by the committee.

CONFERENCE ON RADIATION HAZARDS

A four-day conference of the nation's doctors, dentists, and osteopaths, on the effects of atomic radiation, was held at the Brookhaven National Laboratories in September. Preparation for civil defense was stressed, and those in attendance will relay their knowledge to medical groups in their communities.

TEN NORTHEAST STATES DRAFT MUTUAL AID PROGRAM

Governor Dewey of New York suggested at the Eastern Conference on Civil Defense in New York on September 22 and 23, that mutual aid civil defense agreements be made among the ten states, Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, Pennsylvania, Delaware, New York, and New Jersey.

Mr. Wadsworth of the Civilian Defense Office of the NSRB, stated at this same meeting that the states were ahead of the federal government in civil defense planning, adding that in some respects the federal government was "not equipped to go ahead at full speed."

An interstate committee has been appointed to draft the ten-state program. Canada will also be asked to participate in drafting the regional pact. Plans for integrating civil defense plans of the provinces of Alberta, Saskatchewan, and British Columbia, with those states across the border are already being made. Gordon Tiffinay, Attorney General of New Hampshire, is the chairman of the ten-state committee.

NEW YORK AND NEW JERSEY SIGN PACT

Governor Thomas E. Dewey and Governor Alfred E. Driscoll have signed a civil defense pact for mutual aid between the states of New York and New Jersey in event of a bombing attack in either or both states. This agreement provides that civil defense agencies in both states shall develop mutual aid in the evacuation and reception of injured and homeless persons as well as in the exchange of "medical, fire, police, public utility, reconnaissance, welfare, transportation and communications personnel, equipment, supplies, and such additional services and facilities as shall be necessary."

Governor Dewey explained that civilian defense forces working in one state would have to have the same powers and immunities which they enjoyed in their native states. "For example," he said, "if the fire departments of Yonkers, White Plains, and Tarrytown are needed in Newark, it is necessary that compensation and insurance policies be continued while the men are outside the state." Enabling legislation will be instituted by the two governors. Mr. Dewey admitted certain doubts about the present legality of the pact but said that "people come ahead of technicalities."

In New York State, civil defense directors have received instructions to begin organizing rescue squads for removing persons from buildings damaged in air raids. One rescue team of ten men will be formed for every 5,000 in the population. It has been suggested that the squads be drawn primarily from the ranks of construction and demolition workers.

NEW YORK CITY TACKLES SHELTER PROBLEM

In New York City, Arthur W. Wallander, Director of Civil Defense, has announced that within the next few weeks signs pointing the way to public air raid shelters will begin appearing in midtown Manhattan. Selection and marking of suitable existing shelters from atomic attack has been the responsibility of the Department of Housing and Buildings in cooperation with building owners. Progress has been made by the Police Department in organizing New York's industrial, commercial, and office buildings for the protection of the occupants against atomic attack. Mr. Wallander has stated that 9,099 of the 17,314 buildings in the city have enrolled in the civil defense plan and 8,445 have appointed the building manager or another person as director of civil defense on the premises. Building managers have been asked to procure a copy of the pamphlet, *You and the Atomic Bomb*[5] and to adapt the general principles to their own premises and plan accordingly. Robert Moses, park commissioner, has been appointed evacuation and rehousing coordinator for civil defense.

Initial steps toward construction of $450,000,000 worth of dual purpose atomic bomb shelters and parking areas under New York City's parks, playgrounds, and buildings have been proposed to the City Council by Jerry Finkelstein, Chairman of the City Planning Commission. Acting Council President Joseph T. Sharkey has stated that he would introduce a resolution urging the federal government to provide $2,000,000 for construction of shelters. He has stated that "we are of the opinion that by the introduction of this legislation and the holding of immediate hearings we can come to some very immediate and definite plans for the protection of the people of this city in the event of an emergency."

Sidney H. Bingham, Chairman of the Board of Transportation, has requested an appropriation from the Board of Estimate for eighteen huge steel floodgates to keep water out of the main subway system of New York City in case of bomb damage to river tunnels. $5,200,000 will be required for their construction and installation.

The immediate recruitment of 219,000 civilians as volunteer air-raid wardens and auxiliary policemen and firemen has been ordered by the city's Director of Civil Defense.

Various air-raid alarm devices have been studied and tested at New York's International Airport at Idlewild, Queens. Mr. Wallander has announced that two hundred sirens used during the last war are being renovated and installed at key points.

Banks, insurance companies, and investment houses in New York City have started microfilming their records and storing the microfilms in vaults far from the danger area. One large bank

[5] Reviewed on page 341 of this issue.

is microfilming at the rate of 60,000 feet per month. New York bankers generally believe their vaults will afford good protection against atomic destruction, but fear that these vaults might be inaccessible for long periods after an atomic attack.

CHICAGO HOLDS CONFERENCE ON RESULTS OF TEST

Eight hundred civil defense leaders from twenty states, Alaska, Hawaii, and the United Kingdom, met in Chicago to discuss the results of the third of the civil defense exercises planned by the NSRB.[6] Eighty-two speakers discussed proposed solutions to the problems theoretically arising as the result of the fall of three atomic bombs on Chicago.

Daniel A. Sullivan, of the Chicago civil defense organization, informed the meeting that measures taken to meet the emergency would have enabled the city to recover from the attack within two weeks. During this time, he said, all casualties would have been cared for, all homeless sheltered, and industrial production would have been restored to 90 per cent of normal. On the other hand, Chicago's lack of defensive equipment was emphasized by Fire Chief Frank C. McAuliffe. He disclosed a sad lack in conventional wired communications, all types of radio communications, and radiation survey equipment. With proper provision for such equipment it would have been possible to devise a simpler and more efficient operational plan.

Eric H. Biddle, NSRB consultant, told observers that the results of the Chicago test would be used to develop an over-all national blueprint for states and communities preparing their civil defense plans.

Twenty-two thousand postal workers in Chicago are being trained in the latest first-aid methods, and plans call for the use of the post office's more than 1,000 trucks as emergency ambulances. Some 5,000 first-aid kits will be placed in mail storage boxes throughout the city.

The public school buildings are being prepared as emergency shelters or hospitals.

CALIFORNIA ENACTS CIVIL DEFENSE LEGISLATION

Less than seven days after Governor Earl Warren appeared before the California state legislature to ask for passage of bills covering civil defense, he had before him about 35 measures passed by both houses, embodying almost his entire program. There is a $1,000,000 appropriation, of which $475,000 will go for civil defense proper, $25,000 for setting up a "Little FBI" to check on loyalty of volunteers, and $400,000 for a state security force to supplant the National Guard called into federal service. The Governor has also been authorized to negotiate mutual aid pacts with neighboring states and Mexico. A $75,000,000 fund was made available for use in event of a catastrophe.

Governor Warren has appointed Major General Walter M. Robertson as the state director of civil defense.

The states of California, Arizona, and Nevada have already linked plans for mutual assistance in event of an atomic disaster.[7]

ITALY

Italy has decided to create a corps of civil defense volunteers that will be ready to go into action in case of war or natural disaster. A new measure has been passed creating in the Ministry of the Interior a new section to be known as the Department of Civil Defense Services. Its task will be to coordinate all civil services that aim at protecting the population and essential factories during war. It will be authorized to requisition goods and services and to provide immediately for the recruitment of volunteer civil defense workers.

BRITAIN TESTS DEFENSE PLANS

Mock atomic attacks were held in England early in October. Five-hundred thousand persons were presumed to have been killed and almost one million made homeless in these make-believe raids. The Royal Air Force's "total defense" plan was revealed as far from perfect.

REVIEW OF NEW MANUALS ON CIVILIAN PROTECTION

Atomic Attack: A Manual for Survival. By JOHN L. BALDERSTON, JR. and GORDON W. HEWES. Los Angeles: Council on Atomic Implications, Inc., 1950. Sold and distributed only by Culver Products Co., 3631 Eastham Drive, Culver City, California, Pp. 55. $1.00.

This manual concentrates on the unannounced atomic attack which requires more pre-attack thinking than raids preceded by warnings. Detailed instructions concerning preparations for and behavior during the attack are first given in outline form, followed by a discussion of the reasons for the recommended procedures. The book seems to suffer from a lack of knowledge of the extent to which the average reader will be prepared to go in his planning, e.g., the purchase of a Geiger counter and an acquaintance with its operation is recommended for all; the immediate replacement of all glass house windows with plexiglass or lucite (or safety glass) is advised. It is recommended that children be taught to fall "instantly" to the floor face down, elbow out, forehead on elbow, eyes shut, and that they practice this exercise at night as they are getting into bed. It is to be feared that, although such advice is good, the public will react unfavorably and reject also the remainder of what would otherwise be an effective booklet.

Atomic Warfare. [British] Home Office Civil Defense Manual of Basic Training, Volume II, Pamphlet No. 6. London: His Majesty's Stationery Office, 1950. Pp. 60. (Pagination not continuous, as new pages may be added to its loose-leaf format at a later date.)[8] Available for 50¢ from British Information Services, 30 Rockefeller Plaza, New York City.

The object of this pamphlet is to provide a short manual of practical information about the atomic bomb and its effects. It is based on the known effects of the type of bombs used against the two Japanese cities of Hiroshima and Nagasaki, but considers, in addi-

[6] Mayor Zeidler discusses these exercises in his article on pages 337 and 341 of this issue.

[7] See *Bulletin*, VI (October, 1950), 316.

[8] Four of the missing pages, occurring after the chapter on "Radioactivity," were the subject of speculation in an article, "The Missing Pages," by Mr. Ritchie Calder in the August 5 issue of the *New Statesman and Nation*. Mr. Calder inferred that the authorities had withdrawn a section dealing with the long-term biological effects of radioactivity in order to avoid marring the impression that the atomic bomb is "just another weapon." Mr. Calder ignores the fact that four or five missing pages occur at the end of every chapter of this loose-leaf volume, thus invalidating his claim that radioactivity has been singled out for censorship.

tion, low-ground or water bursts. The booklet begins with a discussion of the known methods of attack, gives a general description of the explosion, and describes the dangers resulting from heat flash, from radioactivity, both immediate and delayed and from blast. It concludes with a discussion of elementary nuclear physics. The entire manual is written in terms quite understandable to the layman. There are twenty-four excellent photographs of the effects of the Hiroshima and Nagasaki bombs accompanied by explanatory notes showing blast effects on various types of structures, including large buildings, homes, and air-raid shelters. The book is essentially a description of the effects of atomic weapons with general discussions of precautionary measures to be taken beforehand and relief measures to be instituted afterward. It is not a manual for personal survival but is intended to supply background and working knowledge for all those associated with civil defense planning.

You and the Atomic Bomb. What To Do in Case of Atomic Attack. New York State Civil Defense Commission Public Pamphlet No. 1. Available from Department E, Life Magazine, 9 Rockefeller Plaza, New York 20, New York. Pp. 33. 10 cents a copy; reduced rates for bulk orders.

This small pamphlet describes in a concise manner the precautionary steps to be taken in case of an atomic air raid. What will happen in case of an air burst and ground or water bursts is stated, and then those procedures which may in many cases spell the difference between survival and destruction are listed. Radiation and fire hazards are given special discussion and first-aid measures described.

How to Survive an Atomic Bomb. By RICHARD GERSTELL. New York: Bantam Books, October 1950. Pp. 149. $0.25. Available on newsstands.

This book gives an excellent discussion in question and answer form of

1) What an atomic explosion may be expected to be like;

2) How to prepare for atomic attack;

3) What to do when it happens, with or without warning;

4) How to behave afterward.

The statements of the types of damage to be anticipated and the attempts to give a realistic estimate of the radiation hazards involved are specially commendable. The information and advice presented are of an extremely practical nature and are given in such a way as to be appreciated by the general public and conducive to positive action. The book concludes with a section telling what each family can do to aid the civil defense program. Clear-cut directions are given for those simple steps which, if taken by individuals during and after an atomic bomb attack, and anticipated beforehand, may result in the saving of their lives.

Zeidler: Community Problems and the NSRB Plan

(Continued from page 337)

ture of civil defense sections and their operation with other sections are most complex.

* * *

There is little to be gained in discussing the many issues involved in civil defense organization revealed by the Chicago exercise and the resulting problems which have been aired at the meeting of mayors. A course of action is open.

This is the answer to what cities can do:

1. They must make their own estimate concerning the immediacy of the danger by keeping abreast of developments in the international scene. This can be done by thoroughly reading reliable newspapers and by following the comments of several news magazines and publications. Estimates on the foreign situation which were given to the mayors by military experts were close to the estimates one derives from wide reading.

2. On the basis of these estimates, city officials should develop their education program and present it to their own citizens. A properly educated citizenry will reduce public apathy.

3. Cities should set up an organizational structure similar to those recommended in either the Hopley report or *United States Civil Defense.* Most city patterns now follow these plans.

4. Large cities should encourage surrounding communities to conform to the central pattern with organizations built on similar patterns, using similar titles.

5. Cities should evaluate their target value. Zone by zone they should see what community facilities are most vulnerable.

6. Cities should decide what they need in order to protect these zones.

7. They should inventory their potentials and resources in meeting their needs. Deficiencies will be apparent from this study.

8. Cities should check with their neighbors to see what can be done to remedy their deficiencies.

9. Cities can then appeal to the state and federal government for financial or other help in filling needs which cannot be met with community resources.

No state or federal financial program can be forthcoming until local communities know what they actually need. As local plans evolve, state and federal patterns will develop.

* * *

Many cities have completed their organization charts and are now wrestling with the task of uniting parts of their organizations into operating companies.

As an example, a plan of the City of Milwaukee proposes that Safety, Civilian Relief, and Medical Battalions be established. A Safety Battalion will consist of a fire-fighting company, a clearance and demolition company, a rescue company, and a utilities service company. Additional units of less than company strength will be a medical services and first-aid unit, a communications unit, police escort unit, bomb reconnaissance unit, and a radiation detection unit. These battalions will be dispersed.

Civilian Relief Battalions will deal with registration, identification, information, emergency feeding, clothing, and billeting. Units will operate shelters and mobile relief units.

Medical Service Battalions raise some basic problems which will not be discussed here. Their tasks will be to operate major and temporary hospitals and first-aid stations.

* * *

The publication of the Hopley report, *The Effects of Atomic Weapons* and now *United States Civil Defense* have produced enough basic literature to enable each community to attack its own problems at once. In addition, enough sound theory has been enunciated in the August-September issue of the *Bulletin of the Atomic Scientists* to assist basic decisions on how much weight to put on dispersal or protective construction in each community. For the present, local initiative must do the rest until one or the other of the local plans proves its superiority for federal adoption.

UNITED NATIONS ATOMIC ENERGY NEWS

Francis W. Carpenter

Mr. Carpenter, who reports the activities of the United Nations Atomic Energy Commission for the Bulletin, is a member of the staff of the Associated Press. He has covered the work of the UNAEC since its first meeting in June 1946.

SECRETARY of State Dean Acheson started the peace ball rolling in his opening address to the General Assembly. He proposed a four-point plan for strengthening the General Assembly in the interests of maintaining peace and combatting aggression. The Acheson plan appeared before the General Assembly, with some slight changes, in the form of a seven-power resolution hailed by many delegates as the most important proposal made to the 1950 Assembly.

Soviet Foreign Minister Andrei Y. Vishinsky, who has taken a milder course at this Assembly, accepted one major point in the Acheson plan but assailed the remainder as a United States maneuver to get around the Security Council and by-pass the veto.

PROVISIONS OF THE SEVEN-POWER RESOLUTION

Here, in brief, is the heart of the Acheson plan as written into the seven-power resolution, in which Canada, France, the Philippines, Turkey, Britain, and Uruguay joined the U.S.:

1. The General Assembly may convene within twenty-four hours if the Security Council is prevented by a veto from acting in the event of a threat to the peace. The Assembly also may act promptly if it is in session when such a threat arises.

Vishinsky fought that provision, saying that he wanted a 14-day period between the time of the call and the convening of the Assembly.

2. The U.N. would establish a peace observation commission which would observe and report on the situation in any area where there is international tension. The U.S. did not at first envision having the Big Five Powers on that group, but Vishinsky insistently urged that the Soviet Union have a seat along with the other big powers, and the U.S. accepted this provision. John Foster Dulles, American delegate, pointed out there could be no veto in this body. This was the only part of the resolution with which the Russians concurred.

3. The General Assembly would recommend that each U.N. member maintain within its national armed forces elements so trained, equipped, and organized that they can be made available promptly for service as U.N. units, upon the recommendation of the Security Council or the General Assembly.

Vishinsky fought this provision on the ground that only the Security Council, with the Military Staff Committee serving under it, could order out troops to maintain peace. He called on the Military Staff Committee to get busy, but Dulles reminded him that the Russians have been boycotting the committee since last January and that the East-West disagreement has stymied the committee since 1947.

4. The General Assembly would establish a collective measures committee of fourteen members to study methods which might be used to maintain and strengthen peace and security. Vishinsky opposed the formation of this committee, again saying it was up to the Security Council and the Military Staff Committee to take such action.

5. The General Assembly would urge U.N. members to respect human rights and fundamental freedoms, especially to achieve economic stability and social progress through the development of underdeveloped areas. This provision was written into the plan at the insistence of Ambassador Hernan Santa Cruz (Chile), President of the U.N. Economic and Social Council. It was tacked on to the Acheson four-point proposals to take care of the economic aspects of peace.

Mainly as the result of two secret talks between Dulles and Vishinsky, the sixty-nation Political Committee of the Assembly approved a fourteen-member Peace Observation Commission made up of the United States, the Soviet Union, Czechoslovakia, France, Britain, China, Colombia, India, Iraq, Israel, New Zealand, Sweden, Pakistan, and Uruguay.

The Political Committee approved the seven-power resolution on October 19, 1950. The vote was 50 in favor, 5 against, and 3 (India, Syria, and Argentina) abstaining. The Soviet bloc of five countries voted against it but made it known that they would take their seats on the Peace Observation Commission. Approval in the General Assembly was indicated by the size of the majority for the plan.

Dulles hailed the committee action as "historic." He issued a statement saying that it showed the U.N. has "taken to heart the lesson of Korea and will have consolidated and invigorated its means to repress aggression."

RESOLUTION CALLING FOR BIG-FIVE MEETING

Two days later—October 21—the Political Committee approved unanimously a resolution by Iraq and Syria recommending that the five great powers listed in the charter—the United States, France, Britain, China, and the Soviet Union—meet and discuss all problems which are likely to threaten international peace and hamper the activities of the United Nations "with a view to their resolving fundamental differences and reaching agreement in accordance with the spirit and letter of the charter."

Fifty-nine countries voted for this resolution. The sixtieth, Iceland, was absent. At the committee meeting Dulles warned against raising false

hopes. He and Secretary Acheson have made it clear that the United States is interested in Soviet deeds for peace rather than Soviet words.

On his part, Vishinsky has said that he, too, wants deeds instead of words —and there the matter rested in mid-October.

SOVIET PROPOSALS FOR PEACE

With these resolutions out of the way, the Political Committee turned to the major Soviet item for this session. In brief, the Soviet Union would have the Assembly:

1. Condemn propaganda in favor of a new war now being conducted in a number of states and prohibit such propaganda.
2. Prohibit unconditionally the use of atomic bombs and institute a system of international control.
3. Declare that the first government to use the atomic weapon, or any other means for the mass destruction of human beings, against any country will commit a crime against humanity and be regarded as a war criminal.
4. Express the desire that the United States, Britain, France, China, and the Soviet Union should combine their efforts for peace and conclude among themselves a pact for the strengthening of peace.
5. Ask the five great powers to reduce their present armed forces of all kinds by one-third during 1950 and consider the question of a further reduction of armed forces at one of its forthcoming sessions.

All of the Soviet proposals have been made before in U.N. assemblies and knocked down by big votes, except the point regarding war criminals. It was evident in their early talks about their proposals that the Russians placed great stress on this point.

PROSPECTS FOR CONTROL OF ATOMIC ENERGY

There has been no hint of a break in the atomic energy stalemate and no sign that talks among the six sponsoring powers will be resumed. They were disrupted last January when the Russians walked out because of the presence of the Nationalist Chinese. The steering committee of the General Assembly voted to forego any debate on atomic energy control in the Political Committee; the question, then, will go to the floor of the Assembly, where no fruitful discussion of the problem can be anticipated.

President Truman's Proposal for a New U. N. Disarmament Commission

ON OCTOBER 24, in his United Nations Day speech at Lake Success, President Truman proposed that the work of the UNAEC and the U.N. Commission on Conventional Armaments be "revitalized" by continuing it through "a new and consolidated Disarmament Commission." The suggestion that conventional and atomic weapons be considered together has been made by the Soviet delegates repeatedly during the past discussions in the UNAEC, and has been rejected by the United States on the ground that agreement on atomic weapons, considered separately, could be more quickly achieved.

American reluctance to merge the questions was examined in the commentary on the control negotiations given in *Minutes to Midnight:*[1]

"The motivation of this American position has never been, to our knowledge, explained officially, but at that time [September, 1946], it appeared justified in the light of the 'affirmative' approach to atomic energy control adopted in the Acheson-Lilienthal Report: If one considers the purpose of atomic energy negotiations, not merely to bring about atomic disarmament, but to establish world-wide cooperation in developing atomic energy for the benefit of mankind, this positive aim could be compromised by a tie-up with the purely negative effort to reduce armaments. . . .

"Later, when chances for the great cooperative program of atomic energy development began to fade, and the atomic energy control became, even in the eyes of the American policy-makers, primarily a means of eliminating weapons whose existence, in the long run, threatened American security more than it did that of the Soviet Union, the justification of the continued American refusal to make abolition of atomic weapons a part of general disarmament became less obvious. On two occasions, in 1946 and 1950, Senator Tydings has challenged the State Department's attitude on this question, by calling for a combined atomic and conventional disarmament conference: in his view, America was foolish to offer disarmament in the atomic field, in which she had the greater strength, without requesting simultaneous reduction of conventional arms, in which the Soviet Union was more powerful.

"Another aspect of the same problem has been the persistent American refusal to include a census of atomic weapons in the planned general inventory of national weapons. At first, this refusal could be justified by the strategic value to the United States of the Soviet ignorance of the number of our atomic bombs—while we were certain that the Russians had none. After the Soviet Union broke the American monopoly, the validity of this argument became questionable. The USSR undoubtedly knows what amount of fissionable materials is needed to make a bomb; and enough public information has trickled out to permit Soviet experts to estimate —even without the help of spies—the approximate rate of production of fissionable materials in American plants. The 'top secret' of our atomic arsenal has thus become threadbare. On the other hand, the interest of America and its Allies in knowing the rate of production of Soviet bombs is growing. Yet the changed situation does not seem to have changed the American policy; at least, the suggestion of Senator McMahon that America should reveal its bomb stockpile has been met with stern official disapproval. (The Senator made this proposal for a different but not less valid reason—because he considered the knowledge of our atomic arsenal indispensable for intelligent evaluation of the American military situation by Congress and the people.) The insistence of the United States that atomic bombs be excluded from an arms census was confirmed as recently as November, 1949, at the General Assembly meeting in New York—long after the revelation of the atomic explosion in the Soviet Union."

It is interesting to speculate whether the President's new proposal means that America is now willing to reveal its stockpile figures.

The hopeful aspect of this proposal is that, if the suggested Disarmament Commission is created, the talks on international control will at least have a fresh setting, and one of the declared obstacles to Soviet agreement will have been surmounted.

1 Eugene Rabinowitch, *Minutes to Midnight. The International Control of Atomic Energy* (Chicago: Bulletin of the Atomic Scientists, 1950), p. 50.

BOOKS

"Minutes to Midnight" Three Reviews

I

Minutes to Midnight: The International Control of Atomic Energy. Edited, with commentary, by EUGENE RABINOWITCH. Chicago: Bulletin of the Atomic Scientists, 1950. Pp. 128. $1.00.

MIDNIGHT is a dark hour, and *Minutes to Midnight* must tell a darkening story. For this is the record of the efforts in the United Nations to control the atomic weapon, as thoughtfully and usefully edited by Dr. Eugene Rabinowitch, of the *Bulletin of the Atomic Scientists.*

It is a tale that history has not yet finished, and it is a warning. Dr. Rabinowitch underlines the chances that both the United States and the Soviet Union may soon have "the wherewithal to destroy all the cities of the world," even the human race itself. Growing stockpiles themselves make new difficulties for any control, for "the finished weapons are so easy to conceal, so difficult to trace." And how will any U.N. controller know for certain that a nation has really declared all its atomic weapons?

There is no facile optimism in this 128-page compendium of the major documents of U.N. sessions and some of the significant American discussions outside. But as Carlos P. Romulo, of the Philippines, former U.N. General Assembly president, says in the Introduction, "a thorough understanding of the problem and of its implications is the first step toward its solution." Dr. Rabinowitch, expressing his own personal views, does seek to be constructive.

As to the record: The 8-by-11-inch magazine format is somewhat overwhelming, and the black and yellow binding a bit intimidating. But the story within is well told. The use of the early memoranda and reports by Dr. Leo Szilard, the James Franck committee, Henry L. Stimson, the Carnegie Endowment for International Peace, and Quincy Wright give a useful and interesting background. The U.N. records are embellished with Dr. Rabinowitch's own commentaries and set against events such as the Truman Doctrine, the Marshall Plan, the Czechoslovak Communist coup.

At the end are *Bulletin* articles by Cuthbert Daniel and Arthur Squires and by David F. Cavers, urging shutdowns of large-scale production plants at least for the present, plus Dr. Rabinowitch's own views of the prospects.

Anyone long associated with the negotiations might wish other points had been included. In particular, there would be the records of 1946 U.N. scientific conversations and 1946 and 1947 control committee talks that led most nations to accept the basic principle of international operation of major plants—and even Soviet scientist S. P. Alexandrov to indorse "managerial control" for uranium 235 separation plants at this time. These valuable preliminary documents, originally secret, have now been declassified. Unfortunately, the U.N. has never made them available in any printed form for the public. But no one can cover all phases, and space is always an editor's problem.

There is, unfortunately, no mention of the fact that the U.N. system has made some start on promoting peaceful uses of atomic energy—one of the great U.N. opportunities. For nearly two years, the World Health Organization has been channeling radioisotopes to Latin America. The U.N. has itself published a scientific bibliography and given its radio facilities to publicize some isotope work.

As to interpretations: With a number of the book's views, it is quite possible to disagree. But generally the basic facts are there, and the reader can himself judge. It would be good if public indifference had indeed been shocked by the announced end of the American monopoly and plans for superbombs (page 10)—but public and governmental apathy is in fact altogether too manifest at U.N.

It is good to have it stressed (page 38) that the deadlock is "clearly traceable to the basic idea of the Acheson-Lilienthal plan"—the need for U.N. operation of major plants—rather than, as so many still seem to think, to the argument over Bernard Baruch's proposals for eliminating atomic vetoes.

It is definitely not to be agreed that appointment of Warren R. Austin and Frederick Osborn as American atomic negotiators in 1947 to succeed the highly independent and skillful Baruch team "meant that from now on atomic energy negotiations were to become a part of the bitter diplomatic game with the Soviet Union—a game which soon was to become known as the 'cold war'" (page 69). In fact, Mr. Austin—who was not "a regular State Department man," despite this assertion on page 68—and General Osborn came along with hopes of conciliation and even some belief that Mr. Baruch had been too tough. The frustrations of negotiating later hardened both newcomers. It is not correct that Soviet Professor Dmitri Skobeltsyn "was only permitted to sit in on these (1947) discussions as an observer," as page 69 says—and in fact, page 72's footnote accurately notes that he "declined participation" in two working groups. It was a typical and regrettable post-1946 case of Soviet non-cooperation in technical phases.

The statement is made (page 113) that "the little that has transpired about the six-power meetings in 1950 does not show any change in the situation worth reporting here." But it should be worth recording that the American-British-French-Chinese-Canadian-Russian atomic talks broke off January 19, 1950—not over an atomic problem—but because the Soviets walked out in protest against the presence of the Chinese Nationalists at the talks.

This, in itself, symbolizes the Soviet view of atomic energy as only one more political issue—and perhaps bargaining point—despite their propaganda moralizing. As page 87 soundly puts it in an earlier setting, "the Soviet leaders apparently did not consider the atomic bomb problem of top political priority, requiring fast action," and probably Andrei Gromyko's only instructions for a long time were to "keep talking."

There are some other questionable points, and some less important factual and typographical errors.

As to the conclusions: Dr. Rabinowitch well points out a number of issues which the United States never clearly defined. For instance, there is

the question whether all atomic weapons—or only national bombs—should be prohibited. There is the problem of just what the stages and timing should be on the way to full control. These still-open items have been left unnecessarily to become Soviet talking points. Dr. Rabinowitch notes the Western silence that greeted Mr. Gromyko's 1947 suggestions that majority proposals for quota controls might help lead to agreement. These suggestions unfortunately were never followed up by the Soviets either, and in 1949, Soviet Foreign Minister Andrei Vishinsky rejected the quota idea as "devoid of sense"—after the Soviet atomic explosion had been achieved.

Dr. Rabinowitch finds little prospect that proposals for a moratorium on large-scale atomic production might open any way out of the deadlock—and in fact, the Soviet bloc denounced the Daniel-Squires views both in the Security Council and in the Assembly last year. He observes that "the psychological effect of a declaration renouncing the use of atomic bombs may, in fact, be considerable"—but he notes that "public opinion may be impressed too strongly" and deem such a promise as a "substitute for an effective control agreement, which it cannot replace."

He suggests new efforts to work out minority guarantees in the international control agency. He observes that a new conference of experts might consider the feasibility of a control scheme of continuous inspection—still rejected by the Soviets—plus quotas. He suggests that Western concessions on the veto, stages, and complete prohibition of atomic weapons might perhaps induce the Soviet Union to let its technical experts, with their newfound know-how, join a new study of the potentialities of inspection.

He winds up, all too truthfully, by stressing that "however difficult a compromise on the technical aspects of atomic energy controls may be, it would be self-deception to think that these problems are the only, or even the main, barrier on the road to survival in the post-Hiroshima world."

With this source data, it should be possible for many a reader to derive his own lessons and perhaps to stimulate some new ideas. Ever optimistic, Mr. Romulo, in his Introduction, says: "The avenues to agreement are limited only by our paucity of vision or lack of good will. There may be some justification for delay; there can be no excuse for failure."

Some of these lessons and ideas might be: First, the unanswered questions should be answered and the unexplored proposals explored—both to ease agreement some day and to convince all peoples of the majority's sincerity. Next, there is a need to state the issues as clearly as possible—and it might be worth while to spell out by U.N. resolution that the peace-wishing nations do not intend to use atomic weapons except against aggression, so defined by international counsel.

And next, there is an opportunity for U.N. to foster even now the peaceful uses of atomic energy—to set up a clearing house for radioisotopes for research and medicine, to publish results of work in these fields, to launch U.N. laboratories as both the Economic and Social Council and the U.N. Educational, Scientific and Cultural Organization have considered.

It would be good for the U.N. to start peaceful atomic cooperation with as many nations as possible on at least minimum research terms. Some day nations must get into the habit of working atomically together. It would be fine if U.N. atomic work produced worth-while scientific discoveries. At the least, it would focus men's minds, through the U.N., on the hopeful promises of atomic energy.

The more hopeful effort is made, the more hope for progress. Lack of effort will surely mean lack of progress. It may be *Minutes to Midnight* today. But at least until man's Atomic Age, a midnight has always been followed by tomorrow.

PETER KIHSS

U.N. Correspondent
New York Herald Tribune

II

IN ATTEMPTING to compile a short but yet comprehensive collection of documentary material on the international control of atomic energy, Professor Rabinowitch undertook a most difficult editorial task. The faculty of the College of the University of Chicago, at whose suggestion this volume was prepared, apparently had in mind a compact and convenient source book of official documents and significant unofficial discussions which would more or less "speak for themselves," permitting the student to analyze the problem from the source materials and to come to his own conclusions with a minimum of guidance or suggestion from editorial comment. Unfortunately, the documents do not lend themselves readily to such treatment. The history of international control is already too long and too complex to be portrayed easily in this manner, at least within the limits of one-hundred thousand words, the approximate length of this book. In addition, many of the most significant materials in the records of the U.N. Atomic Energy Commission are not to be found in the formal reports and resolutions which lend themselves to reprinting in whole or in part, but are contained here and there in the verbatim or summary records of hundreds of committee meetings and need to be pulled out and interpreted to reveal the pattern of events.

In view of these difficulties stemming from the nature of the subject and from the requirements of the documentary format, Professor Rabinowitch has done an excellent job. While keeping the main emphasis on the reprinting of documents, there is enough commentary —about 25 per cent of the total length —to hold the story together and to make this one of the best critical and analytical histories of the subject which has as yet appeared.

This is not to say that the volume does not have its imperfections and limitations—and these entirely aside from the problems created by the documentary format and by limitations of space. There are a number of minor factual inaccuracies; the sources of the materials used, especially in the connecting commentary, are not always adequately identified by footnote references; there is insufficient variation in type face to help the reader distinguish easily between the documentary material and the commentary; and the chronological order of events is somewhat hard to follow at certain points.

As might be expected, there are also major questions of substance and interpretation on which other students of the international control problem would differ with the editor. Some of these would be concerned with the choice of documentary materials. Even within the space limits of the book as now constituted, questions may be raised, for example, on the inclusion of lengthy excerpts from both the Szilard memorandum and the Franck Report in Chapter 1, and from both the Daniel and Squires article and the Cavers article in Chapter 9—and to the exclusion of any material whatsoever from such important sources as J. R. Oppenheimer's article of February 1948 in *Foreign Affairs*, the published articles of Fran-

cois deRose, the Byrnes memoirs, Mr. Baruch's correspondence with Congressman Vorys, Chester Barnard's 1948 lecture at Dartmouth, the speeches of Frederick Osborn and General McNaughton, and significant comment in Great Britain and in Europe.

Differences of opinion may also be expected concerning the emphasis and the interpretation in the commentary—for example, whether the nearest approach to serious negotiation on the part of the Soviets was in February 1947 with the submission of their amendments to the *First Report*, or two or three months later and in a significantly different context; whether the 1948 Assembly session at Paris was treated at sufficient length, especially with respect to the close votes on the motions to approve the Majority Plan "in substance only"; whether the curious relationship, or lack of relationship, between the positions taken by the two principal powers in the Commission on Conventional Armaments and in the Atomic Energy Commission is sufficiently explored.

Finally, there will be those who will regret that Professor Rabinowitch could not find the space to consider and analyze at greater length such critical questions as the problem of actually working out a "strategic balance" in the geographical dispersion of large plutonium-producing facilities; the nature and the extent of the influence exerted by the idea of a lengthy American monopoly of the bomb, and by the assumption of an early and economically important role for atomic power; and the acceptability of the changes in the balance of power which would result from atomic energy control without limitation and control of other armaments and armed forces.

To sum up, this is certainly one of the two or three most useful and objective efforts to date to compress the problem of atomic energy control into reasonable compass for the general reader—even though its original and primary purpose was, apparently, to serve as a college teaching tool. It is to be hoped that with his long and intimate acquaintance with the subject the editor may find the time before too long to give us his critical analysis of the problem without restrictions imposed by time, space, or the need to reprint documents for their own sake.

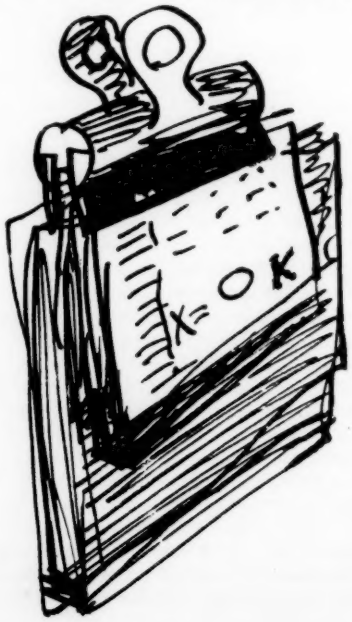
ROBERT W. FRASE

Falls Church, Va.

III

"PERPETUAL peace is, therefore, no empty idea, but a practical thing which, through its gradual solution, is coming always nearer its final realization; and it may well be hoped that progress toward it will be made at more rapid rates of advance in the times to come." So wrote Immanuel Kant more than one hundred and fifty years ago. It need hardly be added that Kant, writing in 1795, was not merely voicing a philosopher's idle dream. Readers of his *Eternal Peace* will recall that he notes at the beginning of the essay that his title may seem fitter for a graveyard than for a living condition of men. But Kant combined in amazing degree the opposite themes of pessimism about human nature and moral optimism about men's future. The more clearly a situation brings out the evil in men, he seemed to argue, the more clear and more compelling the case for the right becomes.

In this interpretation of Kant, *Minutes to Midnight* is a fitting sequel and embodiment of the essay on *Eternal Peace*. The pamphlet brings up to date and systematizes brilliantly an earlier collection of important documents made in 1947 for the use of the Social Sciences third-year course at the College of the University of Chicago. In it we see the scientists, the statesmen, the soldiers struggling with the largest devices for evil yet discovered. The principle of War, and war's inventions, begins the story. But the story is itself as moral as the strict professor of Koenigsberg could have asked—the struggle for a mode in which to formulate morally



and peacefully the employment of the new power. A modern admirer of Kant might wish that his master were here to define for us anew the principles of that formulation.

Minutes to Midnight is, of course, no more a mere morality play than it is a mystery. It is, for teachers of social science like myself, primarily a fascinating study in public policy—in the development of a policy decision of staggering importance. In it the varied strands that go to make policy are woven skillfully into a clear and intelligible pattern. Eugene Rabinowitch has built a lucid and dynamic narrative around the basic documents in the history of proposals for international atomic energy control—from the early memoranda that preceded the first explosion, through the preliminary Big Three agreement, the Acheson-Lilienthal Report, the American proposals in the U.N., the Soviet position, and the attitudes of the other members of the U.N. The military urgencies attending the development of the nuclear bomb, the strategic and moral considerations prompting the American proposals, the play of negotiation, of stubbornness, of suspicion, of persistence and imagination, the semantical sources of misunderstanding, and the substantial political difficulties of American-Soviet communication all are presented here for the student of public policy to study and weigh.

This reviewer has no special competence in the field of negotiations over international control of atomic energy. He finds *Minutes to Midnight* a dispassionate and objective account in which due space seems to be allotted to the various contending views. Beyond that judgment, he relies upon the judgment of the more informed. But he is clear about its eminent importance for college students and for the general public. Its great service is in focusing attention upon the problem of atomic energy control as something that *is* a problem, about which men can and do devise, and about which men should and can come to agree.

Kant's great dictum was that in human affairs moral considerations must have priority over the technical, the scientific. The Kantian view is one that has hardly flourished in the twentieth century. The scientists have tended to have their way with the rest of us. Their power has been unquestioned, and so, in large, have been their credentials. The particular excellence of *Minutes to Midnight* consists in the way in which a Copernican Revolution is revealed in the attitudes of the scientists themselves. Here we see them not mere-

ly submitting to the moral sense of the human community, but leading it, formulating it, of necessity. We see them in active commerce with the official makers of public policy. The public is advised of their attitudes toward science and its role in the community. The public also is made cognizant of the interplay between the scientists and the officially designated representatives of the state. The somewhat tattered adage that social science must overtake the natural sciences seems well on the way to being replaced by the precept of effective cooperation among the practitioners in the several fields.

Minutes to Midnight admits of a variety of readings. For the thorough student it presents a careful and sophisticated combination of the essential historic documents (the Baruch statement, the Acheson-Lilienthal Report, various Soviet statements, the Zero-Zero plan) together with effective interstitial narrative by the editor. For those who must read more rapidly, a judicious sampling of the documents together with the narrative can supply a complete and informative account. As we used it in the College this year, our emphasis was upon the problem of international organization; equally it poses questions of the international organization of national societies, of the role of scientists in those societies, of the control of science by civilian and military authorities, and of the extent to which public opinion in a democratic society must be informed on matters of vital public significance.

On this last point an academic reviewer is perhaps bound to offer a brief remark, again out of Kant. For Kant, the touchstone of morality in public policy was to be found in the appropriateness of full and open publicity. What couldn't be made public was wrong; what must—to be effective—be made public was good. Perhaps the view is too simple for these difficult times. But as an ideal it appears beyond question. That any matters of life and death to all men should remain permanently locked up away from public understanding appears—in a democracy—wrong and suicidal. In the present circumstance, *Minutes to Midnight* is a significant step in bringing such a matter more nearly into the area of public information and understanding.

DONALD MEIKLEJOHN

The College
The University of Chicago

"ATOMIC ENERGY"

Atomic Energy. Edited by R. E. PEIERLS and J. L. CRAMMER. England: May 1950. Distributed in the United States by Allen Lane, Inc., Baltimore, Maryland. $0.35.

THIS collection of nine articles on nuclear energy is worth many times its price to the layman who wants a lucid introduction to this subject. In fact, it provides a quick and instructive look at the more important aspects of this field for the non-nuclear scientist as well. The roster of distinguished contributors includes two of the leading physicists in the wartime British Atomic Mission to this country—Professors Rudolph Peierls and Otto Frisch—as well as Sir John Cockcroft, head of the Atomic Energy Research Establishment at Harwell. American contributors to the volume are Professors Hans Bethe and Philip Morrison, of Cornell.

An introduction by Peierls, setting in historical perspective the large-scale release of atomic energy, shows how this achievement stemmed, with unexpected speed, from the "impractical" pursuit of knowledge for its own sake. The chapter concludes with a brief discussion of the hydrogen bomb, underscoring a profound practical difference between light-element and fission reactions: thermonuclear chain reactions can be used only for destruction.

Bethe traces our conceptions of atoms and nuclei from the eighteenth-century experiments of Lavoisier, through the epochal discoveries of Mendeleyev, Rutherford, Bohr, and Chadwick, and the purely academic atom smashing of the thirties, down to the fission of uranium.

In the two following chapters, the principal methods of producing nuclear fuel—separation of isotopes and production of plutonium—are outlined. The variety of processes which have been devised, based on the first of these methods alone, should disabuse the most innocent reader of the notion that a unique secret, a magic formula, is needed for making a nuclear bomb.

A concise article on the world's supply of uranium and thorium ores—the sole sources of fissionable fuels—is contributed by C. E. Tilley.

Morrison's account of the fast chain reaction explains some of the difficulties in bomb design, e.g., the problem of spontaneous fission. The physical effects of an atomic explosion—the ball of fire, the mushroom, the blast and heat effects, and the nuclear radiations—are graphically described.

Radioactive tracers, along with the high neutron fluxes, which produce them, are surely the most important by-products of nuclear technology; their role in biological and industrial research is outlined by W. J. Arrol and K. Fearnside.[1] The discussion of tracers ends with a note of caution to investigators who contemplate using these substances: research workers must first be trained in the safe handling of radioactive materials, and appropriate laboratory facilities must be provided for safety.

This timely warning is followed by a brief exposition of radiation hazards by J. L. Crammer, who depicts the biological effects of radiation, and the protective measures such as shielding and monitoring employed to cope with the health hazards.

Finally, some insight into the methods of detecting sub-atomic particles is provided by Frisch, who has himself used the tools of nuclear physics with skill and imagination.

The book is well illustrated with a set of plates, including pictures of Harwell's reactor, Gleep, Canada's Chalk River reactor, and France's pile, Zoe, at Fort Chatillon. To those who tend to associate atomic energy exclusively with Oak Ridge or Los Alamos, these photographs provide a salutary reminder that nuclear science, like all science, is international.

The scientist unfamiliar with nuclear reactors will find the chapter by Cockcroft especially rewarding. In addition to explaining how a controlled chain reaction works, he discusses the practical difficulties of building a power pile, and assesses the possibilities of breeding fissionable fuels. If a few paragraphs in this same chapter should prove a bit difficult for the lay reader unaccustomed to exponential functions, he will nevertheless do well to pass lightly over this portion, and read on. With perhaps this sole exception, the book requires no mathematical background. Altogether, the editors have succeeded in producing an eminently authoritative, yet readable volume.

MAURICE M. SHAPIRO

Naval Research Laboratory

[1] Speaking of pile-produced radioisotopes, it is worth mentioning that the British Atomic Energy Establishment at Harwell has been producing an increasing quantity and variety of these valuable substances. Like the products of the Oak Ridge pile, these radioactive materials are shipped to research institutions throughout the world. In the light of this development, which was already in the making at the time of the recent controversy within the U.S. Atomic Energy Commission on foreign shipments of isotopes, it is all the more difficult to understand, much less to justify, the opposition of the lone dissenting commissioner to such exports.

"THE HISTORY OF NATURE"

The History of Nature. By C. F. VON WEIZSACKER. Chicago: University of Chicago Press, 1949. Pp. 191. $3.00.

IN THE present book we have an outline of a cosmology, based upon the present state of knowledge in astronomy, physics, and biology. It is explicitly what all cosmology is implicitly, an effort to gain insight into "the whole edifice of the sciences" possessing human importance because this edifice is connected with the framework of values in which men define the interests that engross them, their hopes and anxieties, the rules they live by. The author conceives that in its particularity, in its specialization, "science is power" and as such lacks ethical relevance. Such relevance accrues to science when it, as one half-circle, can be joined with the half-circle of humanistic interests; the one concerned with the natural conditions of human existence, the other with the human character of natural knowledge.

The first chapters deal with the history of the earth, the spatial structure of the universe, and its time structure. In the last of these the evidence is given from which present estimates of the age of the universe are derived. This brings the author to a discussion of the entropy law and the "historic character" of time. According to Bergson, science has always spatialized time, abstracting the aspect of duration and representing this by geometrical construction, ignoring the reality of present passage, the actual character of the past as against the potential character of the future. Weizsäcker, however, employs the historic character of time in a somewhat Kantian "deduction" of the second law. The entropy concept does not introduce directionality, for in equilibrium the probability of increasing entropy "forward" and "backward" is the same. Granted the historic character of time, however, we resolve the difficulty by simply not applying the entropy law backward. Not the past, in which events are fixed, but the future, in which they are potential, is the domain of probability. By way of brief comment: It is not the ontological character of the past which prohibits probabilistic description. "Backward" statistical predictions are often possible and verifiable; whenever, in fact, equilibrium conditions can be assumed. The general probabilistic formulation of the entropy law is, however, in non-equilibrium terms, and this implicitly defines a time-direction. The empirical ground for such non-equilibrium description is so pervasive that we might correctly replace Weizsäcker's statement "There are fewer empirical elements in this law than in any other law of physics" by its extreme opposite—depending, undoubtedly, on which half of the nature knowledge circle we are occupying.

The fourth chapter comprises a discussion of the concept of infinity. The infinity of God in Christianity was taken over by the secular world view of science, and attributed to nature (infinite space and time) and man (infinite potentiality of progress). Now science is destroying its own myth (finite space and time, heat death). Concepts have meaning only in relation to human practice. The eternal framework is rejected from science as a myth. "Free, knowing man is master of his objects, and for this very reason they lend him no support." What is left is nihilism; at its most honest, "the confession that hopes are not worth holding, that values have collapsed, that life is without meaning." Later, we will see, there is a counterpole to such nihilism. Throughout this chapter, one is reminded strongly, by style and mood, of the existentialist philosophers. The arguments are arguments of the heart; their logic is that of pathos. Those who have not traversed these paths and those who have traversed them for the last time may be unmoved. The knowledge of the inapplicability of old concepts in new regions is only the negative side of progress in knowledge. And the infinity that science has always presupposed, and still presupposes, is not the infinity of space or time, but the infinity of experience; nature is at once knowable and transcendent of knowledge achieved at any given data. This infinity is a fact of concrete human experience not contravened, except through the logic of pathos, by cosmical "heat death."

The following chapters on star systems and stars are among the most interesting. Starting from the explosion theory now widely discussed, but essentially leaving this aside, Weizsäcker works with an initial state of diffuse masses of gas. The hypothetical stages of evolution are clouds, rotatory forms, and spheres. Initially random distribution brings about gravitational condensation, and the clouds so formed develop into rotatory forms. Turbulence prevents this process from going to completion, forming new subordinate clouds. The inner structure gradually collapses into a spherical system, the outer escapes. The initial kinetic energy is partially lost, leaving behind a more orderly spatial distribution. Basically similar process on the small scale lead to Weizsäcker's theory of the formation of stars and planets. In this and later chapters the author develops a generalized evolutionary concept, the "tendency toward the evolution of differentiated forms," applicable also to the discussion of life in subsequent chapters.

Chapters viii and ix are concerned with biological evolution, of which a readable account is given, and with methodological problems of biology. Chapter x, on the Soul, starts with an interesting and, in this reviewer's opinion, sound analysis of the psychic in the tradition of Spinoza, and against the dualism of Descartes. The chapter ends with a discussion of the polarity of instinct and intelligence.

The final chapters, on the outer and inner history of man, are from a scientific viewpoint least adequate. After a brief suggestion of biological origins, the author proceeds to discuss the "morphology" of the rise and fall of civilizations. In the style of Spengler or Toynbee he abstracts completely from what has been established concerning the evolution of man's material mode of existence and its relation with his spiritual evolution. What results is, in this reviewer's opinion, not superior to what usually results in such cases. The detailed study of the evolution of man's material relations with nature and with other men is to human historiography what Newtonian mechanics is to the "history of nature": a knowledgeable discipline without which discussion in a grander style comes to be mainly of autobiographical interest. For contrast the reader is referred to the writings of Gordon Childe, of which one rather naively anti-theoretical anthropologist said, "That's not theory, it's just a summary of what we know."

The final topic of the book is the exposition of the alternative to nihilism in Christian love. The resistance to this love, armed with science as power, plays the role of Anti-Christ. At this point the book ends, with an implied transition to practical matters beyond its scope. Prior to this transition, however, we might wish for some denotation of these qualities. Does Christian love emanate only or mainly from Christian nations? And where, concretely, is Anti-Christ exemplified? In the discussion of human affairs we can least afford to refrain from testing our generalizations by reference to what is particular and complex. Otherwise they drift, willy-nilly, from the domain of knowledge to that of obscurantism.

DAVID HAWKINS
University of Colorado

URANIUM PROCUREMENT POLICIES

THE expanded national defense program will of necessity involve increased requirements for uranium. It is of interest, therefore, to examine the methods adopted by the U.S. Atomic Energy Commission for stimulating the domestic production of uranium. A discussion of these policies has recently been given by Jesse C. Johnson, Manager of the Raw Materials Operations for the Atomic Energy Commission.[1]

The fundamental premise upon which the Commission has proceeded is that primary reliance must be placed on the mining industry of this country in expanding domestic production. While the Commission is prepared to assist by making geological surveys, furnishing free testing and assaying service, and, most important, guaranteeing a market for uranium ore, it is to the prospectors and the mining companies that the Commission looks for the finding, mining, and processing of the uranium ores. A particularly important role is assigned the individual prospector in the detection of new deposits. Although nearly one hundred government geologists are studying occurrences in various parts of the United States, the recent discoveries of the important carnotite deposit at Shiprock, New Mexico, and the autunite-torbernite deposit at Marysvale, Utah, were the work of private prospectors. Geologists, of course, are essential in evaluating and developing ore reserves and in finding ore, but their efforts must be augmented by the hundreds of prospectors and miners, who are always in search of new mineral deposits. The success of the Commission in stimulating the discovery of new deposits can be gauged from the promising prospects which have been uncovered in Colorado, Utah, Arizona, New Mexico, Nevada, Wyoming, Idaho, Montana, and Michigan. Although information is still incomplete, it appears likely that some of these deposits, at least, will become important domestic sources of uranium.

The Atomic Energy Commission has also undertaken to stimulate production by setting guaranteed minimum prices for uranium ore. These guaranteed prices were designed to provide an adequate incentive for private expansion of the domestic uranium industry. In 1948, when the Commission's ore-buying program was announced, only fifteen individual mining operations, employing a total of fifty-five men, were active on the Colorado Plateau. Four of the five process plants established there during the war had been closed, and the fifth was operating at half-capacity in 1947. Under the stimulus of the guaranteed price for uranium, there are now over two hundred different mining operations involving total employment of more than one thousand men. All five processing plants are now operating at full capacity, and new plants are under consideration. Ore production is at an all time high, and this increase has been achieved without direct government financing of private operations.

With respect to other potential sour-

(Continued on page 352)

[1] In a speech delivered before the American Mining Congress, Salt Lake City, Utah, August 30, 1950.

Design approved by
Oak Ridge Institute of Nuclear Studies

here's the new, low-velocity Fume Hood you need for safety

Safe handling of radio-active isotopes is as *special* a job as it is an *important* one. That's why Kewaunee designed this entirely new "Fume Hood of the Future."

The ducts, hood interior, trough and working surface are made of stainless steel. New hood design and baffle system assure a uniform, low-velocity flow of air . . . prevent gases from being carried back toward the face of the hood by reverse eddies or turbulence. No auxiliary duplicate duct system for incoming air is required. The working surface is specially braced to permit a safe loading of 4,000 pounds.

If you're handling, or planning to handle, radio-active materials, it will pay you to write for our literature describing the new Kewaunee No. 3600 Fume Hood.

Also Manufacturers of Wood and Metal Laboratory Equipment

Kewaunee Mfg. Co.
C. G. Campbell, *President*

Representatives in Principal Cities

5088 SOUTH CENTER STREET • ADRIAN, MICHIGAN

SCIENTISTS DISCUSS WAR AND PEACE

BRITISH and American scientists held a two-day discussion in Oxford, England on September 14 and 15. The meeting was arranged by the Atomic Scientists' Association of the United Kingdom and the Federation of American Scientists. Like the FAS, the Atomic Scientists' Association was formed at the end of the war by scientists who had worked in the Manhattan Project, and has carried on a similar program in the United Kingdom. The purpose of the meeting was simply to discuss subjects of mutual interest; no formal action was taken and, indeed, no attempt was made to arrive at conclusions.

Since world control of atomic energy has been of primary concern to both groups, the first subject considered was the status of control negotiations in the U.N. It was felt that political considerations stood in the way of agreement at present and that it was not worth while discussing the technical aspects of the problem or trying to stimulate further discussions in the UNAEC. While it once seemed hopeful to try to reach agreement on atomic control as a separate issue, it now appears unrealistic to consider this problem except in relation to others such as general disarmament. It was agreed that contact between East and West on the diplomatic level was not very promising. If only the "Iron Curtain" could be penetrated, then perhaps it would be possible to build an area of understanding among the peoples themselves. An American member tentatively suggested that the U.S. should try to encourage exchange of students by offering scholarships to students behind the Iron Curtain. If such a thing were possible, the group thought it would be a useful step. On rare occasions Russian scientists have visited England, with a gain to better understanding on both sides.

Although the Oxford meeting occurred before the passage of the McCarran bill, American policy in excluding visitors suspected of communist sympathy came in for considerable criticism. Such exclusion, it was believed, amounts to building an American Iron Curtain, just as dangerous as is the Russian one. In the great middle area between the U.S. and the USSR, the American curtain is a great discouragement to those who have struggled for freedom. The Iron Curtain certainly cannot be removed by erecting another in series with it. As scientists, we must continue to stress the need for international cooperation and a more rational approach to this problem. There was some discussion of the military significance of technical and scientific secrets, but no one felt that these would be seriously threatened by a policy of greater openness.

Professor Niels Bohr's Open Letter to the United Nations (see *Bulletin*, July 1950), which was circulated by both organizations, lays great stress on the importance of "openness" as a necessary condition for stable peace. All concurred in the philosophy expressed in the letter and thought it should receive continued study by our members. The group agreed, however, that a policy of "openness," if adopted by the West solely for propaganda purposes, would do more harm than good. If adopted as a goal toward which policy is continually directed, this concept holds great promise, especially if steps could be taken, like that mentioned above, as evidence of real belief in this goal.

In a recent issue of the *Atomic Scientists News*, Professor Peierls examined the moral problems involved in the use of atomic weapons: if one grants that fighting may be necessary, then the object of war is to win—but without unnecessary destruction of life or property. Atomic weapons are so destructive and so relatively easy to use that the possibility of excessive (and so, immoral) destruction must be a matter of primary concern. A discussion of his arguments led to a consideration of the military importance of atomic weapons. It was agreed that the experience of the last war had shown area bombing to be brutally destructive but not militarily useful. However repulsive it may be to contemplate another war, it is necessary to do so. Military preparations are being made. *How* they are made not only will determine their effectiveness if used, but also may affect the possibility of avoiding war. Although no solutions to these problems were found at the meeting, it was affirmed that because many scientists are in a position to advise the defense agencies, the need for responsible thinking on their part is especially important.

European opinion considers the Stockholm Peace Appeal a very effective piece of propaganda. American scientists certainly favor effective control of atomic weapons but hardly see the object in signing the Appeal when all the United Nations are agreed on the importance of such control. The question is "how", and the Stockholm Appeal ignores the question. Each participant could think of logical objections to signing the Appeal, but these were no reply to an effect which is fundamentally psychological. Our position is difficult because communists cannot see why we should refuse to sign if we are in general agreement with the substance of the statement, and the average man in countries outside the United States is both afraid of the bomb and convinced that it is the responsibility of the United States to avoid its use. There seems to be little that our organizations can do in this regard.

The meeting closed with plans for closer cooperation in the future. It is hoped that an opportunity will arise to hold a simliar discussion meeting next year. The *Bulletin of the Atomic Scientists* is widely read in England, and Americans would enjoy reading the *Atomic Scientists News* (published by the British Atomic Scientists' Association, 7 Victoria Street, London, S.W. 1, England).

The list of participants in the joint meeting follows:

For the British Atomic Scientists' Association: Professor R. E. Peierls, President, Atomic Scientists' Association (Birmingham University); Dr. J. L. Michiels, Editor, *Atomic Scientists News* (Imperial College, London); Dr. Kathleen Lonsdale (University College, London); Professor N. F. Mott (University of Bristol); Professor H. W. B. Skinner (Harwell); Sir G. P. Thomson (Cambridge). For the Federation of American Scientists: Mr. W. A. Higinbotham, Chairman, FAS (Brookhaven Laboratories); Professor A. Roberts, Treasurer, FAS (University of Rochester); Professor S. K. Allison (University of Chicago); Dr. D. L. Hill (Vanderbilt University); Dr. Carson Mark (Los Alamos); Dr. George Placzek (Institute for Advanced Study); Dr. M. Shapiro (Naval Research Laboratory). Also participating was Dr. L. Kowarski of the French Atomic Energy Commission.

WILLIAM A. HIGINBOTHAM
Chairman,
Federation of American Scientists

NEWS IN BRIEF

AEC APPOINTMENTS

Dr. Thomas Keith Glennan, on leave as president of Case Institute of Technology, was sworn in as a member of the Atomic Energy Commission on October 2. The other four members of the commission are at present: Chairman Gordon Dean, lawyer; Dr. Henry D. Smyth, physicist; Sumner Pike, businessman; and Thomas Murray, engineer and financier. This is the first time since the resignation of David E. Lilienthal (February 15) that there has been a full five-man commission.

* * *

Marion W. Boyer has been appointed General Manager of the AEC, to succeed Carroll L. Wilson, who resigned on August 8. Mr. Boyer will take over on November 1, and Carleton Shugg, who has been serving as Acting General Manager, will resume his post as Deputy General Manager.

Mr. Boyer comes to the AEC staff from the senior executive group of the Esso Standard Oil Company where he has been Vice President in charge of manufacturing. His twenty-three years of service with this company have included broad technical experience and the direction of large-scale manufacturing and research operations.

PRIORITIES

On October 3, the National Production Authority instituted a priorities system which gave the Department of Defense and the AEC first call on the nation's industrial production. Under the new system, a "defense order" is to be given priority over all civilian orders on hand at a given plant. Orders which carry the D.O. stamp must be accepted and filled unless this acceptance would jeopardize a previously placed D.O. order. The National Production Authority directive makes it a criminal offense to willfully violate any provisions of the regulation. The mandatory nature of the D.O. stamp will extend down from the original contractor to subcontractors and suppliers.

In line with this priority system, the AEC authorized the managers of its nine operations offices to apply D.O. ratings to direct contracts and purchase orders to meet authorized operations. The authority to apply the priority ratings was limited to: (1) $34 million of deliveries per quarter up to December 31, 1951, for operations program materials; (2) a total of $825 million in commitments on construction programs up to June 30, 1951. The nine AEC operations offices are: Idaho, Chicago, Schenectady, New York City, Hanford, Oak Ridge, Sante Fe (Los Alamos), Raw Materials (Washington, D.C.), and "New Operations Office" (announced on August 2, 1950, after it had been decided to develop H-bombs).

ATOMIC ARCHEOLOGY

The method of dating archeological materials by analysis of isotopic constitution of carbon present in them was first described in 1947.[1] It makes use of the fact that the concentration of carbon 14 in living matter is the same as in the atmosphere (from which carbon is assimilated by plants) but begins to decrease (with a half-life of about 5,000 years) as soon as the carbon exchange with the atmosphere is stopped by death. On September 17, 1950, the New York State Science Service announced that Drs. W. F. Libby and J. R. Arnold (of the Institute for Nuclear Studies at the University of Chicago) in cooperation with Dr. W. A. Ritchie, state archeologist, showed by this method that Indians lived in New York State as early as about 5,000 years ago. (Previous archeological estimates were that the first Indians appeared in New York State 2,000 years ago).

At the October meeting of the National Academy of Sciences in Schenectady, Dr. Libby presented data showing that the Ice Age was at its height in the Midwest 12,000 years ago—and not 20,000 years ago as seemed likely from geological studies.

[1] See Willard F. Libby, "The Radiocarbon Story," *Bulletin*, IV (September 1948), 263-66.

RADIATION INSTRUMENTS

The extent of the development of the private radiation instrument industry was disclosed by the AEC in its second annual Radiation Instrument Catalogue, published in October. It lists 543 commercially available items, which are expected to have a gross yearly sale of about $8 million. There are now 180 different types of detection instruments and accessories; as against 102 in 1949 and 19 in 1947. There are now 84 companies in the field, compared to 67 in 1949 and 9 in 1947. The catalogue describes each item in detail and illustrates almost all of them by either a photograph or drawing. It is on sale for $2.00 by the Office of Technical Services, U. S. Department of Commerce.

QUOTES

Gordon Dean, Chairman of the AEC, on Best Use of Scientific Manpower.

(October 2 speech at University of Michigan)

"Times of emergency require that special thought be given to making the best use of the scientific manpower.

"Industry, education, and the armed services, need to insure that the supply of scientists reaches as far as possible in the same way that they would conserve any other valuable and scarce resource.... One of the contributions of scientists in wartime, as in peacetime, is the carrying on of basic research. Nowadays the lag between discovery and use of knowledge has all but disappeared.... The thing we must not forget in the pressures of the hour is that this country's need to be strong ten or twenty years from now may be just as great as the need one or two or three years from now."

On the Size of the AEC Plant

(October 6 speech to California State Bar Association)

"On January 1 of this year, there had been invested in the physical plant of the atomic energy program more than two billion dollars. The total land area comprises some 2,400 square miles, with individual parcels ranging from an office of 300 square feet in Boston to the 40,000 acres at Hanford. Of the two billion dollars, the Manhattan Engineering District, which preceded the AEC, accounts for about $1,350,000,000. Under present and projected programs capital investment in plant and facilities will be increased.

Stewart Alsop, Washington columnist, on Soviet Bomb Stockpile.

(Chicago Sun Times, October 14)

"It is now possible to give the current accepted intelligence estimates of Soviet atomic bomb production.... they are advanced with considerable confidence and are accepted as a basis for American strategic planning. Russia will have 22 bombs by the end of this year. This figure is considered wholly reliable. So is the estimate of current Soviet atomic production—about two bombs a month. It also is believed confidently that this production rate will not be substantially increased during 1951. This would give a total Soviet stockpile of 46 bombs by January 1, 1952.

The Russians are, however, constructing a great new atomic production plant in the Urals. It is expected that it will come into production at about the beginning of 1952. It is believed that this new plant should step up the Soviet atomic bomb production rate to between five and seven bombs a month. At this rate, by the end of 1955, the stockpile is expected to total approximately 300 bombs. It is believed that this may be the upper limit of Soviet atomic production potential, given known uranium resources within the Kremlin's control."

McCARTHY'S NEW ACCUSATIONS

Senator Joseph McCarthy, in a statement published in the *Congressional Record* on October 20, charged that the scientific profession was the victim of communist infiltration. "This real threat to the nation's security is a matter which has either been ignored by the Atomic Energy Commission or treated far too lightly by this vital administrative agency of the government."

McCarthy claimed that at least 500, among the 50,000 scientists whose biographies appear in *American Men of Science*, have been "openly affiliated with the communist movement through its deceitful and seditious front organizations." He asserted that the Federation of American Scientists was "heavily infiltrated with communist fellow-travellers" and that "the largest scientific body in the world, the American Association for the Advancement of Science (AAAS) was being dominated by a clique of fellow-travellers." In the course of his accusations, the Senator named seven scientists whom he alleged had affiliations with communist front organizations.

McCarthy's charges were immediately severely denounced. Gordon Dean, Chairman of the Atomic Energy Commission said:

"Since the Atomic Energy Commission assumed office on January 1, 1947, no person employed by the Commission or its contractors nor any of the Commission's consultants or advisers has ever been arrested or indicted, much less convicted, of any act of disloyalty. It is deplorable that statements of the type made by Senator McCarthy tend to undermine confidence in the atomic energy program in defiance of the facts of a security record which speaks for itself."

Dr. Howard Meyerhoff, administrative secretary of the AAAS called the charges "utterly irresponsible."

Dr. Clifford Grobstein, of the Federation of American Scientists, labeled them "fantastic nonsense."

Among the seven scientists cited by McCarthy as being members of communist front organizations was Dr. Harold C. Urey, one of America's foremost atomic scientists, who was awarded the Nobel Prize for the discovery of heavy water. Dr. Urey told reporters:

"As usual, Senator McCarthy doesn't know his facts. Up to the end of the war, I worked on the atomic bomb. Since 1945, I have had nothing to do with secret work or the AEC. One very good reason I haven't is that there are too many ignorant politicians of the McCarthy kind who hide behind immunity to abuse and slander those engaged in secret research. Long ago I decided life was too short to spend one's time defending himself and at the same time trying to do scientific research."

Dr. Kirtley Mather, president-elect of the AAAS, who was attacked by McCarthy as having been "affiliated with upwards of forty communist-front organizations," stated: "The first thing is that I am not in the employ of the Atomic Energy Commission nor any other governmental agency in connection with the development of the atomic bomb or any other project under security regulations. Consequently, on that score, Senator McCarthy and the entire country may rest at ease. Senator McCarthy's allegations and irresponsible charges have been so completely discredited that I cannot see how anyone would pay any attention to any further statements that he might make. His charges concerning me are just as false as previous charges hurled at other people."

Dr. Linus Pauling, professor of Chemistry at the California Institute of Technology, and past president of the American Chemical Society, another eminent scientist who was viciously attacked, told reporters that he had never received any classified information of any sort on atomic energy.

McCarthy also accused Mr. Philip Morrison of Cornell University of affiliation with subversive organizations and cited his favorable review of Professor Blackett's book, *Fear, War, and the Bomb*, in the *Bulletin* (February 1949) as evidence of "pro-Soviet leanings." Dr. Morrison replied "I belong to no subversive organizations and I maintain my right to write, speak, and act independently and publicly, whatever Senator McCarthy thinks.

The remaining three scientists who were named: Edward Condon, director of the U.S. Bureau of Standards, William A. Higinbotham, chairman of the FAS and a member of the staff of Brookhaven National Laboratory, and Dr. Lyle Borst, also of Brookhaven, chose to ignore the Senator's polemics.

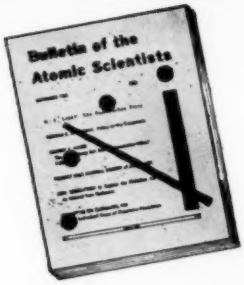
Uranium Procurement

(Continued from page 349)

ces, the Commission feels that most domestic ores will require special price schedules. This is owing to the fact that only in the case of the carnotite deposits where there is a considerable background of experience, can general commitments be made. The Commission is prepared in the case of new sources of ores containing at least 0.2 per cent U 308, to negotiate special contracts in individual cases. Ore-buying schedules for crude ore not covered in Circular No. 1 (high-grade ores) or No. 5 (Colorado Plateau) will be established for each mill. These schedules will be based on the prices set forth in Circular No. 5. In addition to a price guaranteed for eight years, the government will make haulage allowances and payments for other valuable mineral constituents which may be present. The government is willing to pay nearly as much for the uranium content in low-grade ore as for that in high-grade ore, since this will encourage the mining of low-grade deposits such as those at Marysvale, Utah, where some 10,000 tons of 0.3 per cent U 308 ore have been stockpiled.

As long as the government remains the sole purchaser of uranium, no free market can, of course, exist. Under these circumstances the government recognizes the necessity for adequate guarantees both as to price and the period of purchase, if industry is to finance and operate uranium mines and plants.

—J. J. KATZ



Keep Up with the Latest Developments in Atomic Energy...

COMING IN FUTURE ISSUES:

Foreign Policy Today . . . . . Erich Kahler

Promises and Facts in Korea and China . . . . . Clyde Mitchell

The U.S., the U.N., and Far Eastern Agriculture . . Henry Wallace

Loyalty and Intellectual Life . . . . . Edward A. Shils

The Role of the Scientist in Public Affairs
A Symposium

Join the many alert citizens who monthly turn to the BULLETIN OF THE ATOMIC SCIENTISTS for accurate, current, thought-provoking commentary on the most significant international issue of our times.

Subscribe Now!

Bulletin of The Atomic Scientists
53 West Jackson Blvd., Chicago 4, Illinois

Please enter my subscription to the BULLETIN for 1 year at $5.00
My check or money order is enclosed.

Name.....

Street Address .....

City ..... Zone..... State.....

☐ Please send me information about special rates for group subscriptions for schools, colleges and educational organizations to be sent to one address.

Christmas Gift

Order Form

CHRISTMAS GIFT RATES

Bulletin of The Atomic Scientists

One 1 year gift subscription.....$5.00

Each additional subscription.....$4.00

Bulletin of the Atomic Scientists
53 W. Jackson Blvd., Chicago 4, Illinois

Gentlemen:
Please send THE BULLETIN OF THE ATOMIC SCIENTISTS for one year as my gift to

Name_____
Address_____
City_____ Zone____ State____
Gift card to read from_____

Name_____
Address_____
City_____ Zone____ State____
Gift card to read from_____

Name_____
Address_____
City_____ Zone____ State____
Gift card to read from_____

Name_____
Address_____
City_____ Zone____ State____
Gift card to read from_____

Sent By.....
Street .....
City ..... State.....

Please Send Check

or Money Order

with Your List